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PAGE

World-Wide Changes of Temperature. By Charles F. Brooks, Ph.D. . 249

South American Timber Resources and Their Relation to the World's Timber Supply. By Raphael Zon. (1 map) 256

The Mission Range, Montana. By W. M. Davis. (1 map, 13 diagrs., 7 photos) 267

Studies in Economic Geography. By Charles Redway Dryer. (1 map, 1 diagr.) 289

Geographical Record 301

The American Geographical Society

Additions to the Society's Map Collection. 301

North America

Further News of the Explorer Radford's Death 301
Exploration of the Region between Athabaska and Great Slave Lakes . . 302
Forest Fires and Conservation in the Ontario Clay Belt 302
The Florida State Census and 1916 Map 303
Committee to Expedite the Completion of the Topographic Map of the United States 304

South America

The Lumber Markets of South America 304
Bolivia and the Tin Industry 306

Europe

Geographical Instruction in Great Britain 306
Atmospheric Pollution in England and Scotland 307
Navigation in the White Sea 307
A Projected Southern Transcontinental Railroad in Europe 307
The Quaternary Snowline in the Iberian Peninsula 308

Asia

Strategic Geography of the Gallipoli Campaign 309
A New Siberian City 309
Foreign Commerce in the Philippines 309

Polar Regions

Ice Conditions in the Arctic Seas in 1915 310
Probable Loss of Two Russian Arctic Expeditions 310

World as a Whole and Larger Parts

The Japanese Abroad 310
Uniform Pan-American Monetary Unit 311

Physical Geography

Fluctuations of Solar Radiation 311

Geographical News

Weather Charts of the North Atlantic Ocean 311
Personal 311

Geographical Publications (Reviews and Titles of Books, Papers, and Maps) . 313

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THE
GEOGRAPHICAL REVIEW

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WORLD-WIDE CHANGES OF TEMPERATURE

By CHARLES F. BROOKS, Ph.D.
Yale University

Why was the summer of 1916 hot and damp in the central and eastern United States? Why was that of 1915 cool and extraordinarily wet in the Middle West? Why was there so much snow in New England in the winter of 1915 to 1916? Was the weather abnormal in other parts of the world at the same time; and, if so, do past records show the simultaneous occurrence of similar extremes? Does the study of the weather of the world as a whole offer any possibilities for making seasonal forecasts? To these and other similar questions only tentative answers can now be given. Some well-established correlations between temperature departures in widely separated parts of the earth are summarized in this article; and the author has assembled weather data of recent months, which, in the absence of complete data, can be offered only as possible illustrations of these correlations.

As these correlations deal with departures from the average, a summary of the normal distribution of pressure may not be out of place here. The intense heating of the air in the equatorial regions leads to a poleward flow of air in the upper levels. On account of deflection, these winds form great whirls, the centrifugal force of which reduces the atmospheric pressure at the earth's surface in the higher latitudes and piles up the air in high pressure "belts" in the sub-tropics. This would-be orderly arrangement is greatly disturbed in winter by the coldness of the continents and the relative warmth of the oceans, which favor the formation of great high-pressure areas on the land and of low-pressure areas over the water. Thus the sub-polar low pressures are still further reduced over the ocean and more than neutralized over the continents, while the sub-tropical high pressures are increased where there is land and somewhat lowered over the water. In summer, the oceanic sub-tropical "highs" are strengthened, the sub-polar "lows" are weakened; and low-pressure areas develop over the heated continents.

It is evident from the foregoing that the changing temperature relations between land and water strongly influence atmospheric circulation, and, furthermore, that winter temperatures in places far apart may vary together in the same or in opposite directions. Such is markedly the case in the North Atlantic region, where the connections depend largely on the temperature distribution of the ocean surface waters. There, the Iceland cyclone is intensified[1] when the water in the vicinity is warmer than usual and weakened or even replaced by an anticyclone when it is colder.[2] When the pressure at one place is reduced, it must rise correspondingly elsewhere. Thus it is not surprising that the pressure over the Azores is higher than normal 70 to 80 per cent of the time that the pressure of the Iceland cyclone is lower than normal.[3] A similar relation seems to exist between the Aleutian low-pressure area and the North Pacific sub-tropical high-pressure area, the center of which is near the Hawaiian Islands. Furthermore, pressure changes in the continental anticyclones of Eurasia, North America, and Greenland, and in the Aleutian and Iceland cyclones, seem to be of opposite sign.

Not only may warm water intensify the Iceland cyclone and, in turn, the surrounding anticyclones, but also water temperatures below normal in the vicinity of the high-pressure belt tend to raise the pressure locally and so to shift the Azores center,[4] or perhaps to develop a separate one, as over Bermuda.[5] Conversely, local warm water tends to lower the pressure. The water temperatures affect the pressure distribution; the pressure distribution controls the winds and, so, the weather; and, in turn, the winds through ocean currents and surface drift bring about a rearrangement of water temperatures. As western Europe and eastern North America are influenced in common by the North Atlantic air circulation, the weather on the opposite sides and in different parts of the same side should not vary independently.

Professor Hildebrandsson states[6] that, in winter, the weather over part of the ocean lying between Iceland and Norway agrees with that of the north of Europe but is in opposition to the weather in the sub-tropical region, the Azores and the Mediterranean. The same contrast between the north and south is said to occur in North America, but inversely to the relation in Europe; so that if the winter is cold in the north of Europe, it is cold in Mexico and the United States, but mild in the south of Europe and in the north of North America.[7] These relations, however, are often

[1] As in December, 1914, January, February, December, 1915, and January, 1916. These and other months mentioned in the footnotes are suggested as possible illustrations, water temperatures and full pressure data not being available now. See the table.

[2] November, 1915, March, 1916.

[3] J. von Hann: Lehrbuch der Meteorologie, Leipzig, 1915, pp. 637 to 644, gives a good summary of European and other correlations.

[4] To the east—March, December, 1915, January, 1916; to the west—November, 1914.

[5] January, February, April, 1915, January, 1916.

[6] Summary in *Nature*, Vol. 97, 1916, p. 228.

[7] Such was more or less the case in March, 1915.

disturbed by external causes of a superior order, such as the varying heat of the sun.[8] Correlations are usually more evident in winter, when local weather is more under the influence of the atmospheric circulation than in summer, when direct solar control usually dominates.

Let us consider these correlations in detail. In the eastern United States the type of winter weather, marine[9] or continental,[10] is determined largely by the presence or absence, respectively, of the Bermuda "high." The cause of the Bermuda "high" seems to be a cold water surface,[11] which may depend on the temperature and strength of the Labrador Current.[12] The cold water and ice set in motion one winter by a strong Iceland cyclone may serve to strengthen the Bermuda anticyclone and to weaken the Iceland "low" in the next winter. When the Iceland cyclone is strong, northwestern Europe is warmed by strong southwest winds, and eastern North America is cooled by the strong northwest winds of the other side. On the other hand, when the Iceland cyclone is weak, the weather on both sides tends to become normal for the latitude: which means a cold winter in northwestern Europe and a warm one in northeastern North America. Thus arise the alternating cold and warm winters in opposition on the two sides of the Atlantic, which may continue uninterrupted for a decade.[13]

Europe and eastern North America, on the contrary, may be cold at the same time, as in March, 1916. Such is the case when the Iceland "low" is displaced south and extended west, and when many anticylones move on the northern track across the eastern United States. March, 1915, was similar to March, 1916, in the first particular but not in the second.[14] The possible chains of cause and effect may be as follows: (1) intense Iceland cyclone and Azores anticyclone[15]—strengthened trade winds—strong Equatorial Current—warm Gulf Stream in the following winter;[16] (2) strong Iceland cyclone with high northerly winds on the west side[15]—strong Labrador Current with much ice—cold water in the northern part of the ocean.[17]

Also, coincident warm weather may occur in northwestern Europe and eastern North America, as under the conditions prevailing in January, 1915 and 1916. In January, 1916, the pressure was much above normal in a belt extending at least from southern Europe across the Atlantic through

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[8] January, 1916, may have been an illustration of this condition.

[9] January, February, April, 1915, January, 1916.

[10] December, 1914, March, 1915, 1916.

[11] November, 1914, January, 1916, summer, 1916? Southerly winds off the ocean in midsummer bring sultry hot weather to the North Atlantic states.

[12] W. J. Humphreys: Why Some Winters Are Warm and Others Cold in the Eastern United States, *Monthly Weather Rev.*, Vol. 42, 1914, pp. 672-675, 35 charts.

[13] Cf. Hann: *op. cit.*, pp. 639, 640, and C. Abbe, Jr.: Washington and Paris Winters, Table 2, *Monthly Weather Rev.*, Vol. 42, 1914, p. 627 (Opposition Washington-Northern Europe, 1874 to 1883).

[14] See A. J. Henry: Control of March Weather by Pressure Distribution, p. 139, and Charts II, IV, and IX, *Monthly Weather Rev.*, Vol. 44, March, 1916.

[15] Winter 1914-15.

[16] M. W. Campbell Hepworth: The Gulf Stream, *Nature*, Vol. 93, 1914, pp. 441-443. See also footnote 33.

[17] Winter 1915-16.

the southeastern United States to Alaska. The pressure of the Iceland cyclone was about normal, but the southwest winds were strong because of the intensified "high" on the south. In the Pacific, the Aleutian "low" seems to have been pushed south, for the pressures were below normal in the United States west of the Rockies and at Honolulu. These pressure conditions produced intense cold in central North America and mild weather in the East;[18] while England experienced the warmest January on record.[19] This strengthening of the "highs" without a lowering of pressure in the "lows" may have been in response to excessive overflow of air from the tropics.[20] In fact, cold weather in central North America comes with a southward displacement of the Aleutian "low," a movement not wholly unrelated to a similar one on the part of the Iceland center, as seems to be indicated in February and November, 1915, January and March, 1916. In April the connection between the two oceans seems to have been particularly patent, the important pressure reversals between the 19th and 20th being simultaneous in the Azores, the Aleutians, and Hawaii.[21]

Temperatures in the southern hemisphere seem to be no less closely correlated. Mossman[22] has found that there is opposition between the Weddell and Ross Seas in pressure and wind at all seasons and opposition in temperature in winter. Furthermore, there seem to be seasonal contrasts between the Ross Sea, on the one hand, and southern South America, parts of West Australia, and New Zealand, on the other.[23] The winter of 1915 may perhaps be taken as an illustration. In Australia, the winter and greater part of the year were remarkably warm, with prevailing moist, north winds.[24] The Argentine winter was very cold, and the ice conditions in the Weddell Sea were severe.[25] South Africa was apparently colder than usual.[26]

In addition to correlations within a hemisphere there are three types of connection between centers of action on opposite sides of the equator. One is direct, where winds flow from one to another, so that any variation in

[18] Temperature departures: at Havre, Mont., —15°C.; in the East, +3° to 5°C. from normal January temperature (*Monthly Weather Rev.* Vol. 44, 1916, p. 48, and Chart IV). For remarks on Canadian conditions see *Nature*, Vol. 97, 1916, pp. 470-471.

[19] London was warmer by 1°C. than any January at least since 1858 (*Symons's Meteorol. Mag.*, Vol. 51, 1916, p. 7).

[20] See *Monthly Weather Rev.*, Vol. 44, 1916, p. 78; *Bull. Amer. Geogr. Soc.*, Vol. 47, 1915, p. 963. The fact that January, 1916, was abnormally wet at Sta. Lucia and, to some extent, at Cayllorna in the Andes of Peru may have some significance here, as indicative, perhaps, of abnormal doldrum rains.

[21] *Monthly Weather Rev.*, Vol. 44, 1916, p. 210. Before the 20th, pressures were below normal in eastern and southern Alaska and above normal at Honolulu and the Azores; after the 19th, pressures were above normal in Alaska (eastern and southern) and below normal at Honolulu and the Azores.

[22] Review, *Geogr. Rev.*, Vol. 1, 1916, p. 323.

[23] See also R. C. Mossman: Southern Hemisphere Seasonal Correlations, *Symons's Meteorol. Mag.*, Vols. 48 and 49, 1913 and 1914.

[24] *Symons's Meteorol. Mag.*, Vol. 51, 1916, pp. 4-6; and *Nature*, Vol. 97, 1916, p. 471.

[25] *Geogr. Rev.*, Vol. 2, 1916, pp. 54-57.

[26] Temperatures at Cape Town and Johannesburg from *Symons's Meteorol. Mag.* were compared with those shown in Bartholomew's Physical Atlas, Part III, Pl. 10, allowance being made for the sea-level "reduction" of the latter.

DEPARTURES IN TEMPERATURE, RAINFALL, AND CONTROLLING CENTERS OF ACTION

		EUROPE						NORTH AMERICA									
		London		Iceland cyclone		Azores anticyclone		Bermuda		St. Johns, N. F.			Washington, D. C.		Pierre, S. D.		
		T	R	Pr	Po	Pr	Po	Pr	T	Pr	T	R	T	R	Pr	T	R
1914	Nov....	+0.9	+	−1	0	+2	W	+3	−0.4	−3	0.1	+	+0.2	—	+1	+5.4	—
	Dec....	+1.5	+	−8	SE	+4	0	+1	+1.3	+2	−2.2	—	−1.8	+	+6	−2.8	—
1915	Jan....	+0.7	+	−2	SE	+4	W	+2	+0.8	+2	+1.2	—	+1.5	+	−2	+1.0	+
	Feb....	+0.4	+	−4	SE	+4	0	−1	+0.2	+5	+1.4	0	+2.4	0	+1	+3.6	+
	Mar....	+0.2	—	−10	far SW	−3	far NE	−8	−2.5	−22	+2.8	—	−1.9	—	+9	−4.8	—
	April...	0.0	—	−3	NE	+8	NE	−2	−0.7	+3	+2.4	—	+3.5	—	0	+4.6	+
	Nov....	−2.4	0	+3	E	0	N	−1	−1.2	−6	+2.2	+	+0.7	—	−3	+3.7	+
	Dec....	+2.3	+	−3	SE	+	E	−1	−1.7	−7	+2.3	0	−0.5	—	−1	+3.2	—
	Jan....	+4.0	—	−1	E	+4	E	+7	−1.1	−5	−1.1	—	+3.8	—	+4	−6.4	0
	Feb....	0.0	+	0	N	+10	N	+2	+2.6	0	−0.5	+	−0.2	0	+6	+1.3	—
1916	Mar....	−1.3	+		far SW	.....	.....	.....	.....	−8	−1.3	0	−2.4	—	−2	2.8	—
	April...	+0.6	—	.....	.....	.....	.....	−2	+0.1	−2	+1.4	—	+0.2	0	+3	−1.1	—
	May....	+1.8	0	.....	.....	.....	.....	+1	−0.9	−8	+0.8	+	+1.4	—	−2	−1.3	+
	June...	−2.4	0	.....	.....	.....	.....	−1	−2.0	+3	+0.9	—	−1.7	+	+1	−3.0	—
	July....	−0.8	—	.....	.....	.....	.....	+1		.....			+0.7	0	−1	+3	
	Aug....	.....		.....	.....	.....	.....	+1		.....			+0.9	—	+1	−0.6	+

Abbreviations:

T: departure of monthly mean temperature from the normal, C. degrees.

R: departure of total rainfall of the month from the normal; 0 indicates less than 10%.

Pr: departure of month's mean pressure from normal; units millibars (or kilobars), 1=0.03 inches of mercury, approximately.

Po: position of the center of lowest or highest pressure relative to the normal.

Sources: (Iceland and Azores pressures having been derived from map comparisons, or inferred, are uncertain.)

November, 1914, to April, 1915—

Charts IX, *Monthly Weather Rev.*, Vols. 43-44, Nov., 1915, to April, 1916; and tables, *ibid.*, Vols. 42-43, Nov.-Apr., 1915.

November, 1915, to January, 1916—

Monthly pressure maps of Europe in *Das Wetter*, Vols. 32 and 33, Nov., 1915, to Jan., 1916.

Maps of mean monthly pressure, Bartholomew's Physical Atlas, Part III, Pl. 12.

Monthly Weather Rev., tables, November, 1915, to January, 1916.

February to June, 1916—

Monthly Weather Rev., tables, Feb. to June, 1916.

Symons's Meteorol. Mag., Vol. 51, "Weather of the Month."

London data from *Symons's Meteorol. Mag.*; North American data from *Monthly Weather Rev.*

July and August, 1916—

Symons's Meteorol. Mag., Vol. 51, "Weather of the Month."

Washington daily weather maps of U. S. Weather Bureau.

either may be felt in the other hemisphere. On this basis, forecasts are made of the character of the southwest-monsoon rainfall in India,[27] and of the height of the Nile flood.[28] A second type of correlation is that of simultaneous expression of a common cause. Thus, when the sun's heat is more intense and produces a lower pressure in the equatorial regions, as at a time of sunspot maximum like the present, the polar pressures may rise and polar weather may then be colder.[29] It is possible that the following

[27] Summary in *Nature*, Vol. 96, 1916, p. 657; extensive review, *Quart. Journ. Roy. Meteorol. Soc.*, Vol. 42, 1916, pp. 129-132. The forecast for 1916 is summarized in *Nature*, Vol. 97, 1916, p. 490.

[28] *Scientific American*, Vol. 110, 1914, p. 392.

[29] Although Blanford (see Hann: *op. cit.*, p. 641) finds correlation of low tropical pressures and high polar pressures, with sunspot maxima, the recent investigations of Dr. G. T. Walker (review, *Bull. Amer. Geogr. Soc.*, Vol. 47, 1915, p. 963) question such a relation.

weather conditions in the middle of 1915 had such a common origin: warm damp winter in Australia, warm summer in the southern United States;[30] extraordinary ice conditions reported by Shackleton in the Weddell Sea, cold winter in southern South America; unusual ice in Arctic waters reported by the Danes[31] north of Iceland and by MacMillan's expedition west of Greenland;[32] pressures above normal and temperatures below normal in Canada and Alaska;[30] cool and very wet weather in the central United States.[30] It is suggestive, also, that in the central United States the three very wet Mays and Junes occurring in the last thirty-five years came in 1892, 1903, and 1915—all during sunspot maxima (the average period from one sunspot maximum to another is 11.4 years).

A third type of correlation is the delayed, indirect effect which operates through the medium of ocean currents.[33] The Gulf Stream, for instance, is supported by the Equatorial Current, the strength and temperature of which depends on the trade winds on both sides of the equator. Although this control of the weather of one period over that of a later one has been mentioned, an immediate, though speculative, example may be added here. It seems possible that the character of the summer of 1916 was connected in some degree with the weather of the summer of 1915. The warmth of the Gulf region communicated slowly by the Gulf Stream to the northeastern Atlantic may have had some part in producing the intensity of the Iceland cyclone in December, 1915. This strength of the Iceland cyclone probably set in motion southwards the accumulated ice in Greenland waters, the first effect of which was to raise the pressure about Iceland and so to give England the weather which culminated in the extraordinarily wet and snowy March (see table). In April, the reports of pack-ice off Newfoundland, with the establishment of a more or less permanent "high" east of New England, indicated, perhaps, further progress of the ice. In the northeastern United States, in April, May, and June, 1916, the resulting on-shore winds off the cool ocean brought cool wet weather; but in July, the damp ocean winds from the south were warm. To the stagnant anticyclone in the east, which at once made gentle winds and prevented rapid movement of cyclones across the United States, may be ascribed, in part at least, the July hot spell of the Middle West. It seems clear that the weather near the sources of ocean currents and the strength of the driving winds have effects thousands of miles away and months later.[34]

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[30] See discussions of "The Weather of the Month," "Forecast and Warnings," charts and tables in *Monthly Weather Rev.*, Vol. 43, 1915, May to August inclusive.

[31] *Nature*, Vol. 97, 1916, p. 248.

[32] *Geogr. Rev.*, Vol. 2, 1916, p. 65.

[33] "Meteorological Aspects of Oceanography" is the title of an article by Hans Pettersson in the *Monthly Weather Rev.*, Vol. 44, 1916, pp. 338-341, which deals with this subject, particularly in relation to seasonal forecasts.

[34] A successful prediction of the temperature over northwestern Europe last winter was made by P. H. Gallé, who based his forecast on the close positive correlation between the strength of the North Atlantic trade winds from May to October and the temperature over northwestern Europe the following December to February. See note in *Nature*, Vol. 97, 1916, p. 526.

The weather in widely separated parts of the earth is correlated because of the extensive control of the large belts and centers of atmospheric action. In the North Atlantic, for example, the strength, positions, and relations of the Iceland cyclone and of the Azores anticyclone dominate the weather of the adjacent region; and the resulting movements of surface waters of different temperatures change these centers of action. Similar relations seem to exist elsewhere. These are subsequent, however, to changes in the sun's radiation, which produce immediate, world-wide pressure alterations. Any possibilities for widespread seasonal forecasts must rest, therefore, first on an ability to forecast solar changes and, second, on a knowledge of the immediate and subsequent atmospheric effects of such variations.

SOUTH AMERICAN TIMBER RESOURCES AND THEIR RELATION TO THE WORLD'S TIMBER SUPPLY*

By RAPHAEL ZON
U. S. Forest Service

The forest resources of South America are very great, but just how great no one at present can tell, for vast areas known to be forested are as yet entirely unexplored. Therefore any estimates must necessarily be in the nature of very rough approximations, which later explorations and surveys may entirely upset. On the basis of the information now available, the total forest area of South America may be placed in the neighborhood of 3,000,000 square miles (7,787,000 square kilometers, or 1,924,000,000 acres). By countries, this area may be distributed roughly as follows:

TABLE I—FOREST AREAS OF SOUTH AMERICA BY COUNTRIES (GENERAL TABLE)

COUNTRY	FOREST AREA IN SQUARE MILES	MILLION ACRES	FOREST AREA PER 100 INHABITANTS IN SQUARE MILES	FOREST AREA IN PER CENT OF TOTAL LAND AREA
Argentina	231,000	147	3.0	20
Bolivia	284,000	181	12.0	55
Brazil	1,541,000	988	9.0	48
Chile	59,000	38	15.0	15
Colombia	241,000	155	5.0	55
Ecuador	145,000	93	10.0	67
Guiana	64,000	40	3.0	29
Paraguay	84,000	54	10.0	80
Peru	176,000	112	10.0	25
Uruguay	No forests of commercial importance			
Venezuela	181,000	116	7.0	45
Total or Average	3,006,000	1,924	8.0	38

The commercial value of these vast forests is still very little known. Botanically, the South American forests, particularly those near the equator and along the river bottoms, consist of a large number of species. "On a single acre it is hardly possible to find two or three trees of the same kind." This botanical wealth of species can not be used as a measure, however, of commercial value. The reasons for the widespread use of wood are its lightness, combined with strength, and the ease with which it can be worked. It is these qualities that make wood almost indispensable to our civilization. What is demanded, especially in the international markets, is a light, strong, easily workable timber which can be supplied in large quantities and delivered at a low price. Such timber has so far been supplied by the northern coniferous and temperate hardwood forests

* Read on January 3, 1916, before Section III of the Second Pan-American Scientific Congress, Washington, D. C.

of Europe and North America. The richest forests in the world commercially, those of northern Russia and Sweden, botanically are very poor. They consist of only two species—the Scotch pine and the spruce.

If the South American tropical forests contain only a few commercially useful tree varieties which are scattered among a large number of other species of low or no present commercial value at all, the high cost of logging them may make the exploitation of such forests unprofitable. As a matter of fact, this has been exactly the case with nearly all of the tropical forests until recently. The few trees known at present as commercially valuable are invariably found scattered among a great many unutilizable ones. In order to cut and remove the valuable species it is necessary, therefore, to cut and leave a good deal of useless material. A more intimate study within recent years of the physical properties of tropical woods by the United States foresters in the Philippines has shown, however, that the forests of the Philippine Islands and the Malay Archipelago contain a vast group of trees (*Dipterocarpa*) which, although they are hardwoods, possess many of the qualities of the common woods used in international trade, namely, lightness, strength, and softness. The presence of a large number of utilizable woods in other tropical forests, in addition to the rare woods, such as dye woods, rosewood, mahogany, and others, would place them on an entirely new commercial basis, since they would contribute to the future supply of common hardwood timber for the world.

If further studies show that the forests of South America contain, in addition to the rare dye woods, *quebracho*, greenheart, mahogany, etc., a large number of utilizable hardwoods similar to *cedro*, which is already being exported from there, the economic importance of the South American forests will be great. Our present knowledge of the technical properties of the woods of the South American forests is very inadequate. From what we do know at present, however, there are only three species which, because of their technical properties, may furnish woods suitable for wide use. These are the Paraná pine (*Araucaria brasiliensis*) and the Chilean pine (*Araucaria imbricata*), two coniferous species, and the Spanish cedar, or *cedro* (*Cedrela*, several species), which is a soft hardwood. Most of the other hardwoods known at present are exceedingly hard and heavy and, therefore, difficult to saw. How hard they are may be judged from the fact that sawmill machinery manufactured in the United States especially for sawing hardwoods in South America and guaranteed in advance to cut 20,000 feet of hardwoods daily has, in innumerable tests, developed a maximum capacity of only 7,500 feet a day.

The following is an attempt to estimate very roughly the areas occupied by the different classes of South American woods and on the basis of these estimates to outline the possible economic importance of South American forest wealth. The total forest area of 1,924,000,000 acres may be divided into distinct forest regions (map, Fig. 1) according to the prevailing com-

mercial species: (I) the coniferous forest, comprising (1) stands of nearly pure Paraná pine and (2) stands of Chilean pine mixed with some larch, cedar, and South American beech, which may be designated as the Antarctic beech region; (II) the vast hardwood forest which comprises (3) the tropical hardwood forest, in which Spanish cedar is invariably present, and (4) the forest of subtropical hardwoods; (5) stands in which *quebracho* forms the important species, and (6) stands in which greenheart predominates.

1. The Paraná pine forest region[1] occupies an area of approximately 309,000 square miles, or 200,000,000 acres (802,000 square kilometers), the greatest part in the southeastern portion of Brazil in the states of Rio Grande do Sul, Santa Catharina, Paraná, São Paulo, southern Minas Geraes, and Matto Grosso. The range of this pine is between the parallels of 18° and 32° S. It derives its name from the state of Paraná in Brazil, where it is most plentiful and is commercially the most important tree. In Paraná one company alone owns a solid forest, much of which is still in the primitive state, aggregating 3,000,000,000 feet and averaging over 4,000 feet to the acre. Some stands of Paraná pine contain as much as 15,000 or 20,000 board feet to the acre.

2. The Antarctic beech region[2] is the only other region in which conifers are found, such as the Chilean pine, larch, and cedar. The Chilean pine is botanically very close to the Paraná pine. This region lies chiefly on the slopes of the Andes and occupies in all an area of approximately 96,000 square miles (61,000,000 acres), or 248,000 square kilometers.

3. The tropical and subtropical hardwoods[3] occupy by far the largest areas. The tropical hardwoods are found over an area of some one and a half million square miles (more than one billion acres), and the subtropical hardwoods over an area of 259,000 square miles (165,000,000 acres). The most valuable tree of the tropical hardwood forest is the *cedro*. *Cedro* (*Cedrela odorata* and other species) constitutes one of Brazil's most important export hardwoods and is commonly known in the United States as Spanish cedar. This species does not form pure forests over large areas but is found scattered among the tropical hardwoods throughout Brazil from the Amazon to the Paraná River. The largest and highest-grade logs are cut from the forests in the state of São Paulo and in the territory lying south and immediately west of it. In this portion of Brazil the wood is in high favor commercially and is consumed in large quantities. Its softness, the ease with which it can be worked, its ability to

[1] R. E. Simmons: Lumber Markets of the East Coast of South America, *Bur. of Foreign and Domestic Commerce Special Agents Series No. 112*, Washington, 1916. [Information with regard to the rest of the continent is to be found in the same writer's "Lumber Markets of the West and North Coasts of South America" in the same series, No. 117. Both of these reports are abstracted in the "Geographical Record" in this number.—EDIT. NOTE.]

[2] Bailey Willis: Northern Patagonia, Vol. 1 and atlas. Published for the Ministry of Public Works, Argentine Republic, by Charles Scribner's Sons, New York, 1914.

[3] Theodore Roosevelt: Through the Brazilian Wilderness, Scribner, New York, 1914.

Raphael Zon: The Forest Resources of the World, *Forest Service Bulletin 83*, U. S. Dept. of Agriculture, 1910.

hold paint and take a polish, as well as its high grade, commend it for many special uses and make it first in economic importance of all the Brazilian hardwoods. It enters aggressively into competition with the imported pines and in certain markets is preferred for a number of uses. In Brazil it is being cut annually at the rate of about 47,000,000 board feet. Its range coincides practically with that of the tropical hardwoods. Of the vast variety of other hardwoods which are found in mixture with cedar, *peroba* and *acapu* (*Voucapoua americana*) are the two species which may be considered among the chief woods for export from the Amazon Valley to the European markets. At any rate, these species, more than any other hardwoods, meet locally the need for hardwoods and, therefore, make unnecessary the importation of American and European hardwood lumber.

4. The hardwoods in which *quebracho*[4] forms the commercially important species are found chiefly in northern Argentina, in the provinces of Tucumán, Santiago del Estero, and Santa Fé, the territories of Formosa and the Chaco, and in the Chaco of Paraguay. Botanically, however, *quebracho* is distributed over a much larger area. The total possible yield from the forest areas where *quebracho* occurs in commercial quantities is estimated at 168,000,000 tons, while the present yearly consumption of the wood for all purposes is a little less than 1,000,000 tons. Since the average yield per acre is approximately two tons of the wood, the total forest area in which *quebracho* occurs in commercial quantities is about 84,000,000 acres. The small yield per acre makes it necessary to cut over about 500,000 acres annually in order to secure the 1,000,000 tons of wood which are in demand. *Quebracho* wood is one of the principal commercial products of South America, its main value being for tannin extract and cross ties.

5. Greenheart (*Nectanda rodioei*),[5] with which is associated mora (*Dimorphandra mora*), is the most important tree of British Guiana, the only place where it is being cut extensively. There it is found most abundantly along the Essequibo, Demerara, and Berbice Rivers. Greenheart grows along the seacoast and watercourses, seldom extending more than 50 miles inland and never more than 100 miles. It reaches its best development in a strip of country between two and three miles wide immediately behind the alluvial deposit which fringes the seacoast. The present export of timber from British Guiana is in the neighborhood of 200,000 cubic feet, which, on the whole, is smaller than it was in the past, when in certain years as much as 400,000 cubic feet were exported. Greenheart is chiefly used in ship and dock building because of its immunity against the ravages of the *terado*. It is found over a range of over 240,000 square miles, or about 154,000,000 acres (625,000 square kilometers).

[4] C. D. Mell: Quebracho Wood and Its Substitutes, *Forest Service Circular 202*, U. S. Dept. of Agriculture, Washington, 1912.

[5] C. W. Anderson: Forests of British Guiana: General Report on the Forests of the Easily Accessible Districts of the Colony. Dept. of Lands and Mines, Georgetown, Demerara, 1912.

The following tables (Tables II and III) and map (Fig. 1)[6] show in detail the different forest areas and their location:

TABLE II—FOREST REGIONS OF SOUTH AMERICA

	SQUARE MILES	MILLION ACRES	SQUARE KILOMETERS
Tropical hardwoods	1,613,000	1,032	4,177,805
Paraná pine	309,000	200	801,611
Subtropical hardwoods	259,000	165	670,761
Greenheart-mora forest	241,000	154	624,785
Mahogany forest	84,000	54	218,672
Quebracho forest	404,000	258	1,045,627
Chilean pine-beech forest	96,000	61	247,557
Total	3,006,000	1,924	7,786,818

From this very inadequate survey of the commercially valuable timber resources of South America as we know them now, it may be seen that the real forest wealth of South America is not as great as one would naturally think from the vastness of the forest area, particularly if one bears in mind that the commercial forest does not occur in a solid body over the entire area and that a great deal of it has already been destroyed. Thus in Chile, according to Federico Albert,[7] Inspector General of Forests, Hunting, and Fisheries, the commercial forest area has now been reduced to 5,000,000 acres. Of the 39,000,000 acres classed as woodland, 9,000,000 are pasture forest, 18,500,000 only firewood forest, 6,000,000 furnish only poles and stakes, leaving only about 5,000,000 acres of really commercial forest.

That light, strong, and easily workable timber is the one that is most in demand even in South America is shown by the fact that in Argentina 80 per cent of the total annual consumption of lumber is imported from the United States, Canada, and Europe, and consists chiefly of pine and spruce, while the native hardwoods make up only about 10 per cent. The same is true of Uruguay. In Brazil, where the forest area of hardwoods is very large, 40 per cent of the total consumption is covered by importations of pine and spruce from the United States, Canada, and Europe, 30 per cent is supplied by the native pines, and the remaining 30 per cent is made up of the native hardwoods. In Chile, the third in importance of the South American republics, 55 per cent of the total wood consumption is covered by American and European importations and 45 per cent supplied by the native woods.

It is true that of the 47,000,000 board feet of Paraná pine which is cut annually in Brazil, about 15,000,000 board feet is exported; yet at the same time the United States, Canada, and Europe are sending pine to Brazil, largely for similar uses, in quantities averaging over four times this

[6] In preparing the map, the boundaries of the several forest regions have been determined by W. H. Lamb, in charge of investigations on forest distribution in the Forest Service.

[7] Federico Albert: The Forests of Chile, *Monthly Bull. of Agric. Intelligence and Plant Diseases*, Vol. 5, 1914, pp. 1535-1541, Internatl. Inst. of Agric., Rome.

amount. An analysis of the export and import lumber trade of the whole of South America (see Table IV) shows a condition similar to that in Brazil. Thus, while the importations of lumber in 1912 amounted, exclusive of naval stores, to about $32,000,000, the export of wood, exclusive of rubber, was a little over $9,000,000. Of this, over half was *quebracho* extract logs. The amount of actual wood exports, therefore, was not more than $4,500,000, or about one-seventh as much as the wood imports. It is evident that at present the large forest area of South America does not even supply its home demand for soft, easily workable wood commonly used in general construction work. So much for the coniferous softwoods.

As far as hardwoods are concerned, the present annual cut is almost sufficient to cover the home demand; consequently very little hardwood timber is imported into South America from the United States, Canada, or Europe. Judging from the figures available for Brazil, Uruguay, and Argentina, the native hardwoods form only about 15 per cent of the total amount of wood used in South America, a rather insignificant amount.

At present the lumber industry of South America is still in a primitive condition. The inaccessibility of the forests, the absence of means of transportation, the lack of capital, and the sparseness of the population are undoubtedly responsible. The logging of tropical woods, even with improved methods, will always be a costly operation. Unless all of the mature trees in such a forest are marketable—a condition which can hardly be expected—the valuable species will always be found more or less scattered. To log them, therefore, will involve large expense of cutting roads to where the trees are felled. Furthermore, the tropical hardwoods are, as a rule, cumbersome to handle on account of weight. Not infrequently as many as 40 oxen are required for the transportation of one log. According to some estimates by large logging operators, it would cost $16.80 to haul 1,000 board feet for a distance of 12½ miles. As is mostly the case in all new countries, the public service transportation is expensive in Brazil. A railroad running through one of the most important forest sections charges about $15.90 per thousand feet American log scale for transporting logs a distance of 100 miles. Even in the Paraná pine region, where the timber occurs in almost pure stands, one of the sawmills with a steam-power logging road and modern power skidding and logging machinery figures the cost of logs delivered on skids at the mill at $10.50 per thousand feet, not including stumpage.

The lumber industry is working under many difficulties and is confined to a few species. This explains largely such an apparently anomalous situation as that lumber from native woods is undersold in nearly every important market by high-grade imported lumber, in spite of the fact that the native forests are only from 100 to 300 miles from the points of consumption, while the foreign lumber must be shipped from 4,000 to 5,000 miles and bears an import duty of 100 per cent ad valorem. These difficulties,

TABLE III—FOREST AREAS OF SOUTH AMERICA BY COUNTRIES (DETAILED TABLE)

	PER CENT OF TOTAL FOREST AREA	MILLION ACRES	SQUARE KILOMETERS	AREA PER 100 INHABITANTS IN SQ. KMS.
Argentina				
Chilean pine-beech-cedar forest	15.8	23	94,307	
Subtropical hardwoods	2.9	4	17,682	
Quebracho forest	81.3	120	485,681	
Total forest area	100.0	147	597,670	8.0
Bolivia				
Tropical hardwoods	51.2	93	376,050	
Subtropical hardwoods	17.7	32	129,672	
Quebracho forest	31.1	56	228,693	
Total forest area	100.0	181	734,415	29.1
Brazil				
Tropical hardwoods	76.9	760	3,076,769	
Paraná pine forest	20.3	200	801,611	
Quebracho forest	2.8	28	113,169	
Total forest area	100.0	988	3,991,549	23.0
Chile				
Chilean pine-beech-cedar forest	100.0	38	153,250	
Total forest area	100.0	38	153,250	4.4
Colombia				
Greenheart-mora forest	5.7	9	35,365	
Mahogany forest	26.4	41	165,037	
Subtropical hardwoods	39.6	61	247,557	
Tropical hardwoods	28.3	44	176,826	
Total forest area	100.0	155	624,785	12.3
Ecuador				
Tropical hardwoods	64.2	60	241,662	
Subtropical hardwoods	22.6	21	84,878	
Mahogany forest	13.2	12	49,510	
Total forest area	100.0	93	376,050	25.1
Guiana				
Greenheart-mora forest	89.3	36	147,354	
Tropical hardwoods	10.7	4	17,682	
Total forest area	100.0	40	165,036	7.2
Paraguay				
Quebracho forest	100.0	54	218,084	
Total forest area	100.0	54	218,084	25.7
Peru				
Tropical hardwoods	63.3	71	288,816	
Subtropical hardwoods	36.7	41	167,395	
Total forest area	100.0	112	456,211	9.9
Uruguay				
No forests of commercial importance, the whole country being essentially an extension of the great Argentine plain.				
Venezuela				
Greenheart-mora forest	94.1	109	442,066	
Subtropical hardwoods	5.0	6	23,577	
Mahogany forest	.9	1	4,125	
Total forest area	100.0	116	469,768	17.0

however, are being gradually overcome. The lumbering of the Paraná pine is already on a fairly solid basis and is making rapid progress. It is being developed largely by American lumbermen. At first, without fully understanding the properties of the Paraná wood, they had trouble in handling it; but gradually, as men of more technical training become interested in its manufacture and the problems connected with its kiln-drying are worked out in a practical way, an increasingly greater utilization of the timber is definitely assured. Even now in some states it is the

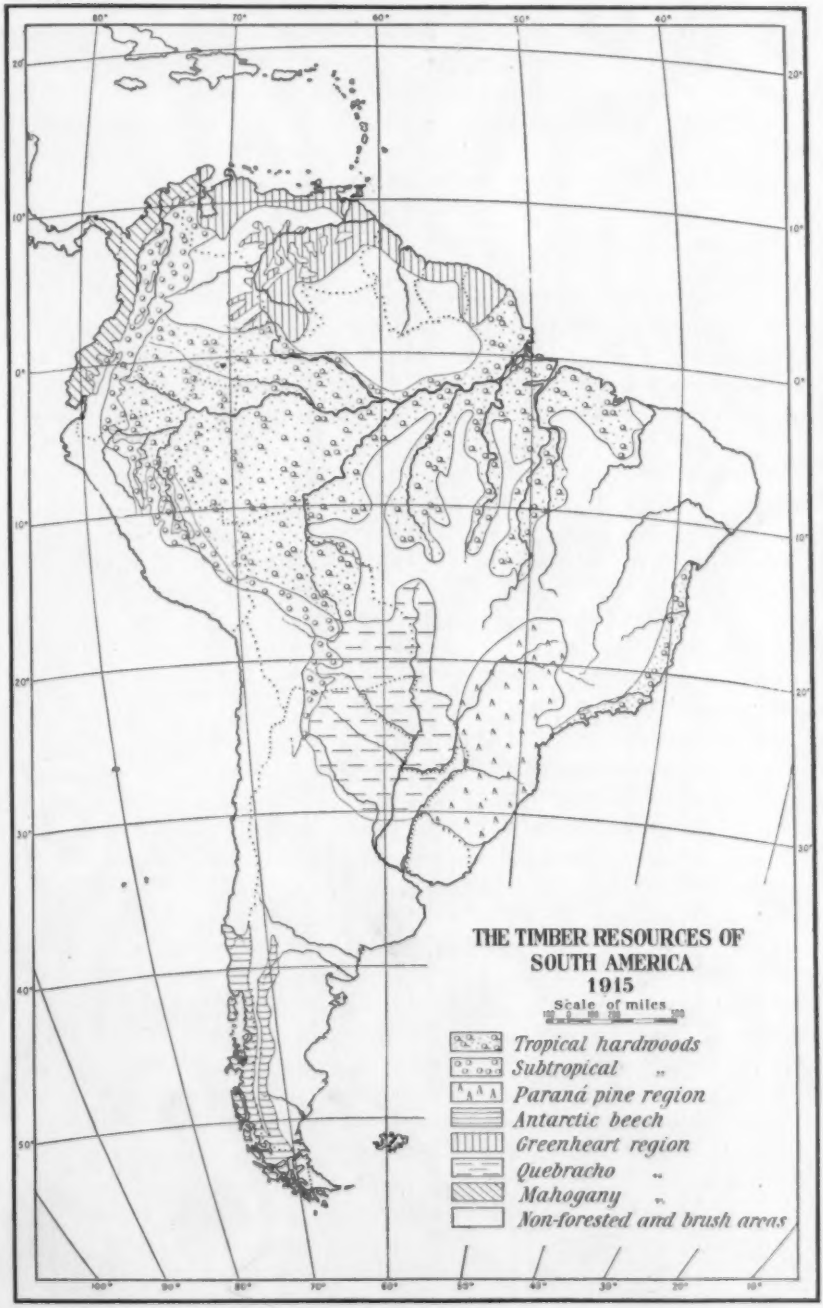

FIG. 1—Map of the commercially valuable forest regions of South America. Scale, 1:50,000,000. The boundaries of the forest regions were determined by W. H. Lamb of the U. S. Forest Service.

TABLE IV—IMPORT AND EXPORT LUMBER TRADE OF SOUTH AMERICA, 1912*

(values in dollars, United States currency)

IMPORTS

	FURNITURE	PINE UNPLANED	WOOD		ROSIN	PINE BLOCKS AND BOARDS	STAVES AND HOOPS	ROUGH, SAWED, PLANED, AND VENEERED	LUMBER AND WOODS	TURPENTINE	MATCHES	TOTAL LUMBER	NAVAL STORES
			UNMFG.	MFG.									
Argentina	2,668,230	13,984,340	.....	.....	.....	.....	.....	.....	.....	.....	.....	16,652,570	.....
Bolivia	130,702	.....	248,087	75,794	.....	.....	.....	.....	.....	.....	.....	454,583	.....
Brazil	871,002	.....	.....	.....	1,593,017	2,768,805	186,883	464,835	.....	.....	.....	4,291,525	1,593,017
Chile	.....	1,331,773	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,331,773	.....
Colombia	.....	.....	.....	.....	.....	.....	.....	.....	317,401	.....	.....	317,401	.....
Ecuador	.....	.....	.....	.....	.....	.....	.....	.....	94,594[a]	.....	26,917	121,511	.....
Guiana													
British	.....	.....	.....	.....	.....	.....	.....	.....	3,846,701	.....	.....	3,846,701	.....
Dutch	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
French	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Paraguay	4,835[b]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,835	.....
Peru	171,631[c]	.....	.....	.....	.....	.....	.....	.....	1,765,916[c]	.....	.....	1,937,547	.....
Uruguay	258,841[c]	.....	.....	.....	.....	.....	.....	.....	2,680,597[c]	.....	.....	2,939,438	.....
Venezuela	.....	.....	.....	.....	.....	.....	.....	.....	.....	8,879	.....	.....	8,879
Total	4,105,241	15,316,113	248,087	75,794	1,593,017	2,768,805	186,883	464,835	8,705,209	8,879	26,917	31,897,884	1,601,896

[a] Rough and finished. [b] Only U. S. reported. No figures for other countries. [c] 1911.

EXPORTS

	QUEBRACHO		TIMBER	WOOD AND LUMBER	BALSAM COPAIBA	QUILLAYA BARK	BALSAM TOLU	TOTAL
	EXTRACT	LOGS						
Argentina	4,667,570	3,443,655	.....	.....	.....	.....	.....	8,111,225
Bolivia	.....	.....	.....	.....	.....	.....	.....	.....
Brazil	.....	.....	.....	.....	.....	.....	.....	.....
Chile	.....	.....	.....	.....	.....	9,287[a]	.....	9,287
Colombia	.....	.....	68,572	15,280	5,910[a]	.....	19,488[a]	109,259
Ecuador	.....	.....	.....	.....	.....	.....	.....	.....
Guiana								
British	.....	.....	62,830	.....	.....	.....	.....	62,830
Dutch	.....	.....	.....	9,839[b]	.....	.....	.....	9,839
French	.....	.....	.....	.....	.....	.....	.....	.....
Paraguay	.....	.....	846,341	.....	.....	.....	.....	846,341
Peru	.....	.....	.....	.....	.....	.....	.....	.....
Uruguay	22,747[b]	.....	.....	.....	.....	.....	.....	22,747
Venezuela	.....	.....	.....	72,439	38,658	.....	.....	111,097
Total	4,690,317	3,443,655	977,743	97,567	44,568	9,287	19,488	9,282,625

[a] Exported to United States. No figures for other countries. [b] 1911.

* From "Commercial Relations of the United States with Foreign Countries, Calendar Year 1912," Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, 1914.

most formidable competitor of Scotch pine, American spruce, and white pine for box making. In southern Brazil it successfully replaces the American yellow pine for doors, flooring, blinds, and ceiling. There seems, therefore, to be very little doubt that in Paraná pine South America has a softwood which can successfully take the place and therefore compete with the softwoods imported from the United States, Canada, and Europe, and that with the greater development of the native lumber industry the importation of the softwoods to South America will gradually decrease and that eventually she will be able to supply her own demand for this kind of timber.

The limited area, however, of these pine forests, together with the fact that South America is still a young country which will have to provide wood for a much larger population than she has now, makes it very doubtful that even with the proper protection and management she will ever become an exporter of softwoods to foreign markets. With regard to hardwoods, however, South America, in spite of the difficulties of primitive methods in logging, is already capable of satisfying practically all of her needs and is even exporting, in addition to extract and dye wood, some of the rarer woods. The vast hardwood forests of South America could undoubtedly be a source of large supplies of tropical hardwoods for interior finish for the world market, if it were not for the fact that the demand for heavy tropical woods will always be limited, and even the use of dye woods is probably coming to an end shortly because of the progress made with chemical dyes. Furthermore, the weight of the tropical woods and the distance from markets will always be a serious obstacle in delivering such woods on a large scale at reasonable prices, especially at a time when wood is coming more and more into competition with wood substitutes. Therefore, unless the South American hardwoods are to be manufactured on the ground and exported as veneer or other partially manufactured product or the cost of logging and transportation is greatly reduced, they will hardly ever become a source of great export.

If our estimates of the timber resources of South America are anywhere correct, several conclusions suggest themselves:

First, in spite of apparently a vast forest area, the extent of commercially really valuable timber is limited, and therefore it would be an obvious error to assume that the timber resources of South America are inexhaustible. The people of the United States have made a similar error in the past. Twenty years ago the white pine in Michigan was regarded as inexhaustible; today 6,000,000 acres which thirty years ago carried the best white pine in the world have been abandoned by their owners for taxes and lie almost wholly waste—a man-made desert, the combined result of a reckless use of the axe and a still more reckless disregard of fire. As it is, attention has already been repeatedly called to the danger of the extinction of the *quebracho*, since little or no check has been placed on the cutting

of this wood. If the present cutting is permitted to continue, according to a very high Argentine authority, few existing *quebracho* trees will be left standing. There is constant outcry for the passing of immediate forestry laws, but as yet this very pressing matter has not obtained its share of consideration from Congress. Not only the *quebracho*, but many other valuable species of trees with which the forests abound are in danger of extinction in the not very distant future as the result of inadequate forestry laws.

Second, the coniferous softwoods of South America will supply only the growing home population, and, therefore, their preservation becomes a matter of national importance, since with the gradual exhaustion of the timber supply of the northern and temperate regions the amount of softwood exported will gradually decrease and the price increase.

Third, South America has a vast amount of hardwoods which is more than sufficient to supply her own needs for all time; but, as far as we know at present, it has comparatively few hardwoods beside Spanish cedar and several extract and dye woods which may figure extensively in export trade. This vast hardwood forest is still unknown and furnishes a fertile field for exploration which may lead to the discovery of many species whose wood properties may change entirely the commercial aspect of the South American forests. The first task, therefore, of South American countries which are interested in the development of their forests is a thorough reconnaissance of their timber resources and a study of the technical properties of the different woods as a basis for an intelligent estimate of what those forests contain and what they have to offer to the lumber market of the world. If further study fails to discover any more valuable species than those already known it will still serve as a basis for a definite forest policy. It will indicate methods of logging and partial manufacture which may make possible a large export trade in these hardwoods. It may show the advisability of confining future management of those forests to the growth of only the most valuable species and the gradual elimination of the vast number of unutilizable trees or forest weeds. Such a policy, together with the rapid growth of the tropical trees, may tend to increase the commercial value of the forests. It may also dictate a definite land policy with regard to the clearing of certain kinds of forests for agricultural purposes and the advisability of retaining others for timber growth. Without such a reconnaissance and determination of the possible uses to which the tropical hardwoods are suited, a systematic and intelligent development of the timber resources can not be undertaken nor capital for their exploitation readily attracted. It is therefore in the interest of the countries whose economic progress depends on the development of their natural resources that such a reconnaissance should be undertaken and carried through as soon as possible.

THE MISSION RANGE, MONTANA

By W. M. DAVIS

Location and General Features. The Mission Range, one of the smaller members of the Rocky Mountains in western Montana, has the appearance, as seen from the west, of a gently tilted and moderately dissected fault block, gradually rising southward through its 70 miles of length, and believed to be composed of deformed rocks, mostly quartzites, of so uniform a resistance that no distinct expression of inner structure is recognized in outer form. It occupies the greater part of the distance between the Northern Pacific and the Great Northern Railways on the 114th meridian west of Greenwich. The steeper face of the range, probably representing the battered fault scarp, looks to the west. At the low northern end the moderately uneven crest emerges from beneath the glacial deposits which floor the broad intermont depression thereabouts at an altitude of 3,000 feet and rises slowly southward to a height of 9,800 feet near an abrupt southern descent, there gaining a maximum local relief of nearly 7,000 feet. The eastern side of the range is said to slope gently; the western face is steep. Thus the slowly rising crest and the long eastern slope suggest that the mountain block is an up-faulted fragment of a formerly worn-down mountain region, perhaps of low enough relief to be called a peneplane. Several other mountain masses in the same region exhibit a widespread accordance of summit altitude and thus support the conclusion that the forms of today are carved in the uplifted surface of a worn-down mountain region.

The mountain crest, slowly descending and dwindling away to the north, wedges off the branch intermont depression of the north-flowing Swan River on the east from the much larger and longer intermont depression of the south-flowing Flathead River and Lake on the west (map, Fig. 1). This depression is the southernmost part of the Rocky Mountain Trench, as it has been called by Daly.[1] In the district here concerned, the depression is limited on the east by the strong slope of the Galton and Swan Ranges of the Rocky Mountains and on the west by the more gentle ascent of the Flathead Mountains. On the gravel and silt plains of the depression, north of the lake, lies the flourishing agricultural town of Kalispell (altitude, 2,950 feet), reached by a southwestward, 15-mile spur from the main line of the Great Northern Railway. On the eastern shore

[1] R. A. Daly: The Nomenclature of the North American Cordillera Between the 47th and 53rd Parallels of Latitude, *Geogr. Journ.*, Vol. 27, 1906, pp. 586-606; see p. 596.

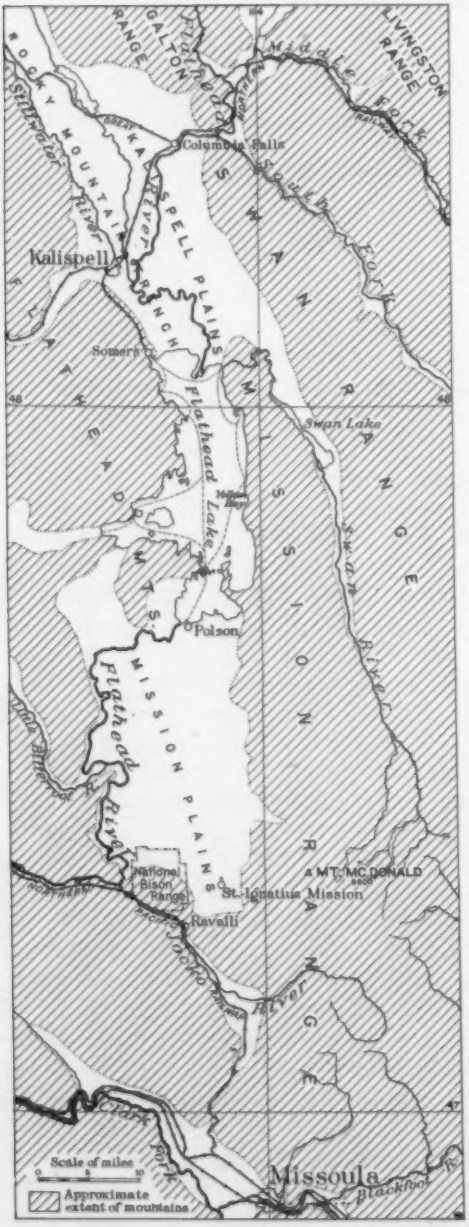

FIG. 1—Sketch-map of the Mission Range region, Montana, with the Flathead intermont depression. Scale, 1:1,100,000.

of Flathead Lake beneath the lower northern part of the Mission Range is the University of Montana Biological Station, the director of which, Professor Morton J. Elrod, has explored the district and published several essays upon it, in which the origin of the range by faulting and its glaciation are briefly mentioned.[2]

My own acquaintance with the Mission Range is brief. In connection with a Shaler Memorial Study in August, 1913, I took a rapid trip 80 miles southward from Kalispell and return and made many notes and sketches of the mountain forms as seen from the lake and plains on the west at distances of one to five or more miles. The diagrams here presented are redrawn from my hurried outlines and represent the range as if it were seen from an elevated point of view several miles to the west. They are roughly generalized figures, suggestive of the kinds of forms there exhibited, rather than sketches of actual details; they undoubtedly exaggerate certain features; they are bare of vegetation; their uncompromising black lines cannot portray the soft-

[2] The Beauties of the Mission Range, *Rocky Mountain Mag.*, 1901, pp. 623-631.

A Biological Reconnaissance in the Vicinity of Flathead Lake, *Bull. Univ. Montana: Biol. Series No. 3*, 1902, pp. 91-182.

The Physiography of the Flathead Lake Region, *ibid.*, No. 5, 1903, pp. 197-203.

ness of the graded slopes; the diagrams are indeed hardly more than caricatures of the picturesque reality; yet if allowance is made for their limitations they may serve to make the following text and the photographs more easily intelligible. The photographs come from the collection of the U. S. Geological Survey, to which my thanks are hereby rendered; some of them are by Dr. C. D. Walcott, others by Mr. R. W. Stone. Their accuracy is delightful, and the abundance of detail in certain views is extraordinary; but the relation of the parts that they so well represent to the whole of the range is nevertheless aided by the rough diagrams.

FIG. 2.—The three belts of the Mission Range.

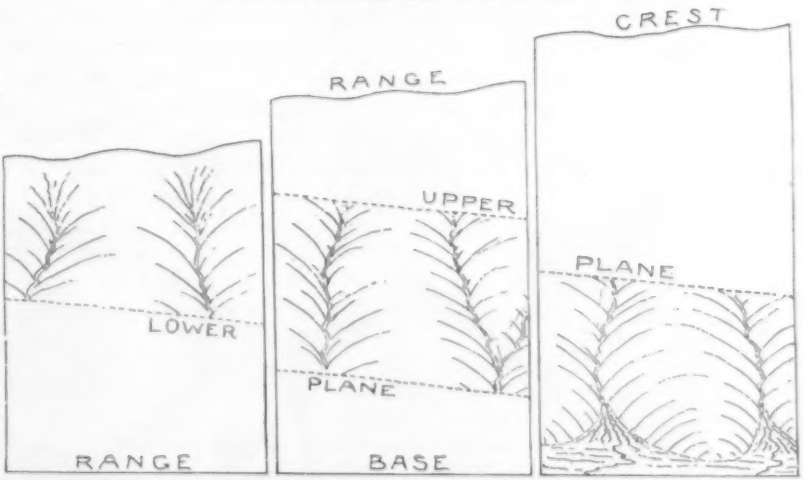

FIG. 3—The normal features of the middle belt.

The Three Belts of the Range. The present features of the Mission Range, as seen from the intermont depression on the west, may be divided, in so far as they are due to erosion since uplift, into three oblique belts, as in Figure 2, by two planes slanting gently to the south and about 1,000 feet apart. Through the middle of the range where the limiting planes overlap all three belts are represented.

The Middle Belt. In the middle belt, confined between the two planes, the mountain-side forms are all due to the normal erosional forces of weather and water. Owing to the overlap of the planes, a continuous descent cannot be made at any one point within this belt from mountain crest to mountain base; the overlap is indeed so great that portions of the belt must be taken, as in Figure 3, at three places in order to show a spur

summit and valley heads as on the left, the mid-descent of a spur and valleys as in the center, and a spur end and piedmont fans as on the right. The crest of the range here shows rounded, waste-covered summits; the slope is diversified by maturely graded, large-textured, full-bodied spurs between the wide-spaced, steep-pitching, apparently consequent valleys of small and rapid streams. The summits and a good part of the graded spurs are treeless. As is usual in forms of this kind the rarity of rock outcrops makes outline sketching difficult; there are not enough lines to express the forms. The concave forward reach of the tapering spurs as they blend into the piedmont plain is far beyond my power of black-line representation in a front view. The well-rounded forms of the spurs suggest that the inferred original fault-scarp of the supposed mountain block is completely destroyed by retrogressive erosion; and, if so, the upper parts of the streams should be regarded as obsequent extensions of the original consequents, inasmuch as they must now discharge to the westward a certain amount of rainfall captured from formerly longer east-flowing consequents. There is no trace of spur-end facets along the western mountain border, such as characterize the up-faulted and less dissected Wasatch Range in Utah; the valleys, instead of preserving their V cross-section to a simple base line, as in the Wasatch, open on fans that form re-entrant cusps between the advancing scallops of the spur ends. What relation exists between the rock structure and the scalloped base line I cannot say.

A characteristic feature of the maturely carved middle belt is the well-organized system of down-hill lines by which the descent of water and waste is made from any point on the slope to the mountain base. All the paths of descent first follow the down-hill element of a well-graded spur

FIG. 4—Northern end of the range emerging from the plains.

side to a stream; then the down-valley element of a stream course to the piedmont plain. The spur-side elements are countless; contiguous elements are nearly parallel to one another, being but slightly convergent or divergent; their declivity changes so slowly and systematically as to insure a steady though very deliberate progress of the continuous waste cover, as it creeps and washes toward a stream. The stream lines are comparatively few, probably not more than eighty or one hundred in the three southern quarters of the range length where streams are normally developed. The rock waste, slowly fed from the spur sides into the streams, is rapidly washed down the channel to the mountain base; for, as well as I could see, the channels seem to be fairly well graded, though they doubtless still retain many little rocky rapids and bouldery pools; and their declivity appears to be such that the streams gain just the velocity that enables

them to do their work of transporting the waste received from the spur sides, with a very small addition supplied by corrasion of beds and banks. The only down-hill lines that do not join a stream are those that follow a spur axis, and these are the lines along which the ascent of the slope is most easily made: their declivity is greatest near mid-height but seldom over 30°, and is much less than that for some distance above the base and below the top.

The Low Northern Belt. In the lower northern belt the smoothly flowing, waste-covered forms of the middle belt are replaced by uneven forms of small texture—bare crags and knobs, cliffs and ledges, channels and hollows—due to recent and severe but immature scouring by a broad and overwhelming glacier of Canadian origin. Similarly immature crags and knobs occur in the glaciated areas of central France[3] and North Wales.[4] Tree growth on the craggy slopes here seen is more abundant than on the waste-covered spurs of the middle belt, and a good share of the surface is thus concealed; but the bare and uneven ledges are so plentifully visible that I felt no doubt of their extending under the tree cover as well. Outline sketching is, however, again difficult because the innumerable rock outcrops now provide details so abundant that there are too many lines to draw; needless to say that the knobs and cliffs shown in my diagrams are not minutely accurate copies of actual forms.

The northern half of this belt forms the northern quarter of the range and lies entirely beneath its limiting plane, as in Figures 4, 5, and 6; it has

FIG. 5—The gradual rise of the scoured northern belt.

an arbitrarily uneven crest, the profile of which lies beneath the northward prolongation of the non-glaciated crest in the middle belt by one or several hundred feet, as if worn down by glacial scouring. The side slope of rubbed and roughened hills and hollows is a medley of unorganized forms; it has no sign of the well-arranged lines of continuous descent by which the middle belt is characterized and no indication of the delicate interdependence of parts that Gilbert long ago, in his classic report on the Henry Mountains, showed to be an essential characteristic of streams and surfaces that had been long enough exposed to the normal processes of subaërial erosion for the development of mature drainage systems: naturally not, for

[3] W. M. Davis: Glacial Erosion in France, Switzerland, and Norway. *Proc. Bost. Soc. Nat. Hist.*, Vol. 29, 1900, pp. 273-322; reference on p. 276.

[4] W. M. Davis: Glacial Erosion in North Wales, *Quart. Journ. Geol. Soc.*, Vol. 65, 1909, pp. 281-350; reference on p. 336.

the irregular slopes here seen are not the work of down-hill washing and creeping by water and weather, but of side-hill scouring and plucking by a huge glacier, moving almost horizontally southward and at so recent a date that small advance toward the development of normally carved forms and toward the establishment of well-organized drainage systems is yet to be seen. There appears, however, as far as I could make out by repeated examination with a field glass, to be some talus at the foot of cliffs and some smooth flooring of detritus gathered in the hollows and there may be small gorges cut in rock sills by the plunging streams. The lines here followed by falling, rolling, and creeping waste are short, irregularly disposed, and of rapidly changing declivity; they radiate in all directions from countless knobs and hillocks, they converge in all directions toward countless channels and hollows: the lines followed by leaping and lagging streams are frequently deflected almost parallel to the range front, in one direction or the other, as if following small troughs worn along the face of the mountain slope; the streams must therefore turn this way and that, they must alternately hurry and loiter, striving to wear down ledges that are too steep and to fill up sags that are too flat, the latter task probably being farther advanced than the former. Streams thus arranged form an elabo-

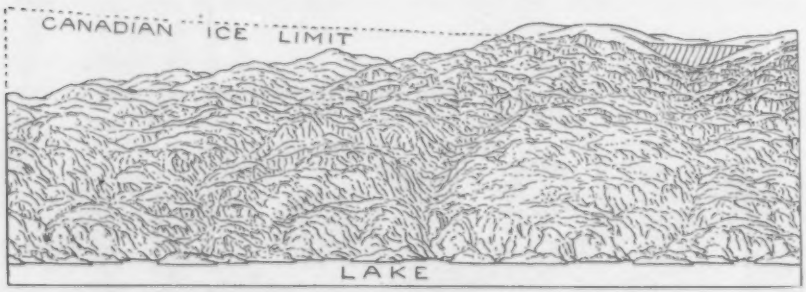

FIG. 6—The scoured northern belt overlapped by the middle belt.

rate branch work; Y-junctions are very frequent, the stems of the smaller upper y's forming the branches of the next lower and larger ones, over and over again. As a result no direct stream lines for the descent of water and waste from the range crest are seen here, and no continuous spur axes to guide paths of direct ascent from the range base. The branch-work stream system thus constituted stands in strong contrast to the single-line streams of the normally eroded middle belt; yet the branch-work streams as well as the single-line streams are consequent, in the sense of following courses offered to them when taking possession of the surfaces that they drain; their differences are chiefly due to difference in the nature of the surfaces offered to their action, and for the rest to differences in their stage of development; for the single-line streams are almost mature, while the branch-work streams are very young: but all this contrast is implied

in saying that the northern end of the range shows "uneven forms due to recent and severe but immature scouring by a broad and overwhelming glacier."

Northern End of the Range. If the range is followed farther north, as in Figure 4, its height decreases with a somewhat regular irregularity until the last visible knobs, deeply scoured and channeled and plucked, more or less detached from one another, rise hardly a hundred feet above the surrounding plain of out-washed glacial gravels and silts diversified by low morainic hills, which here occupies the broad intermont depression and presumably covers a farther northward extension of the range crest underground. Some of the knobs lie somewhat west of the line that farther south follows the mountain base, and this suggests that the strong fault by which the central and southern part of the range is thought to be limited, may here, near the least uplifted end of the mountain block, be represented by an up-warped or up-arched mass of which the western limb corresponds to the underground wing of the fault farther south. Low as the range is here, the rocks of the knobs are resistant and apparently of the same nature as those which form the lofty mountain crest to the south. Evi-

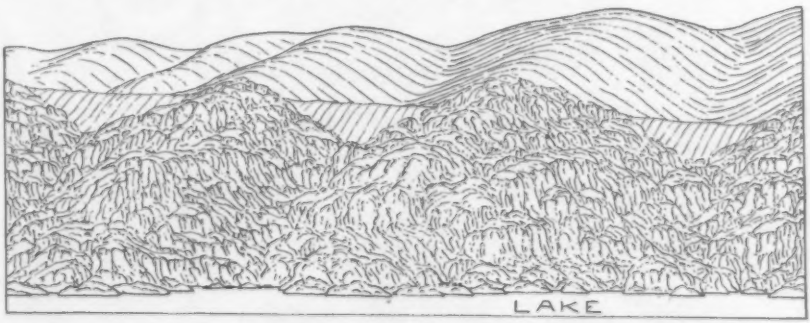

FIG. 7—Morainic embankments between normal summits and scoured slopes.

dently, then, the northward diminution of range height cannot be due to degradation of a once much loftier mass in the present cycle of erosion, but rather to the northward decrease in the uplift of a previously worn-down mass. The range rises highest where the uplift, increasing southward along the edge of the supposed fault block, has its greatest value.

A curious feature of the trailing northern end of the range is its transection by the Swan River, which, instead of making a northward detour and avoiding all the rocky knobs, takes a short cut westward through them on its way from its own valley on the back-slope side of the Mission fault block to the larger Flathead valley on the fault-scarp side. This is presumably a persistent consequence of temporary constraint by the waning mass of the Canadian glacier; if so, search should be made in notches at higher levels in the trailing crest for transverse water-worn channels marking temporary

outlets of a proglacial lake in the upper Swan River valley; and it is quite possible that the highest channel of all may occur at the head of the valley westward around the southern end of the Mission Range or southward over the neighboring hills directly into the valley of Jocko River.

Truncated Spurs and Morainic Embankments. If we now turn southward to the second fourth of the range, where its crest rises above the limit of glaciation, as in Figure 6, the normally rounded summits and the normally hollowed valley heads of the middle belt make their appearance above the rugged slope of glacial erosion. The valleys are barred across by what I take to be morainic embankments (Figs. 7 and 8), which record the height of glacial action to a nicety; the spurs are imperfectly truncated in irregular cliffs and ledges, strongly scoured along the mountain side.

Below the gently slanting line defined by the moraines, the disorderly tumult of bare cliffs and ledges in the imperfectly truncated spur ends forms a striking contrast with the subdued orderliness of the waste-covered higher slopes; the subdued forms of large texture express a long and suc-

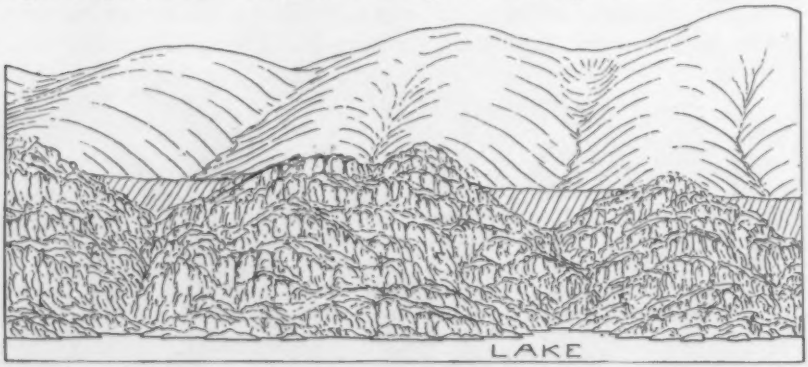

FIG. 8—Normal slopes above scoured slopes.

cessful continuity of degradational processes; the disorderly forms of small texture express a striving and unsuccessful discontinuity. Above, all the local variations of rock structure, such as are determined by the composition, thickness, and attitude of successive beds and by the number and inclination of joints, are practically without influence upon the form of the surface, because local and individual influences are masked by the generalizing effect of the creeping cover of rock waste; below, the masses and planes of structural strength and weakness are strongly expressed in the bared rock faces and fissures of the many cliffs and benches.

The streams in this fourth of the range exhibit a haphazard habit in their plunging courses, for the valleys as well as the spurs are largely obliterated below the line of moraines. Cascades and pools must be frequent in watercourses that are consequent on the smaller forms of so rocky and rugged a mountain side; as far as I could see, little progress towards

establishing a graded profile has been accomplished. In the absence of pronounced spurs and valleys, the whole mountain side here descends like a battered wall and dips under the waters of Flathead Lake, of which the eastern shore line is comparatively simple when viewed as a whole but minutely irregular when viewed in detail. The western shore line is much more sinuous. There are, however, two eastern re-entrants of small size, Woods and Yellow Bays, roughly represented in Figures 7 and 8, which appear to occupy scoured hollows between spur remnants, but as to this I am uncertain; the buildings of the Biological Station of the University of Montana are beautifully situated on the north side of Yellow Bay, where a gravel delta, not shown in the diagram, now occupies part of the original re-entrant.

As one advances farther southward, some of the morainic embankments are trenched by the streams from the normal valleys behind them, as in

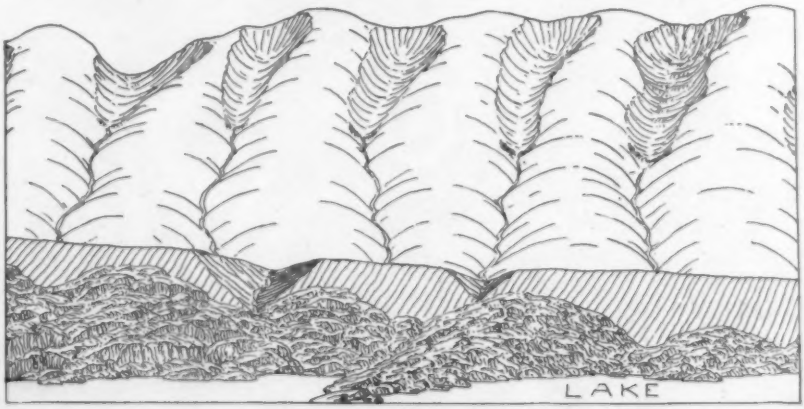

FIG. 9—Small cirques above a continuous moraine.

Figure 9, the spur ends are scoured to less and less height, and their truncation is less and less effective; one of the spurs advances in a low promontory and is continued across the lake by a string of small islands, one of which is shown in Figure 16. The ruggedness of its nearby rocks justifies the generalized details of the glaciated slopes in Figures 7, 8, and 9, although such details are not shown in the photographic view of the range from one of the rocky islands (Fig. 18). Farther on still, the embankments stand at less and less heights above the lake and at the same time become larger and longer, until they ride over the spurs and thus form a long unbroken ridge, which gradually departs from the base of the range, as in Figures 9 and 10. The morainic ridge in this part of its length is truly only about half as high as the 1,500-foot embankment that forms the northern side of the huge morainic amphitheater in which the ancient glacier that followed the valley of the Dora Baltea from the southern side of the Mt.

Blanc group ended on the plains of Italy at Ivrea; nevertheless it constitutes a formidable monument of glacial construction, which becomes especially conspicuous as it swings away from the mountains in the noble terminal moraine, dotted with boulders, that sweeps westward across the intermont depression with a relief of 400 or 500 feet—see Figure 2—and a breadth of one or two miles, separating Flathead Lake on its concave northern side from the Mission Plains, chiefly composed of earlier glacial deposits, on its convex southern side. The lake outlet follows a trench sharply cut across the moraine at the southwestern angle of the lake; the town of Polson lies on the morainic slope next east of the outlet, and gives its name to the moraine.

The truncation of mountain-side spurs by a passing glacier is of familiar occurrence in the valley troughs of formerly glaciated mountain ranges; it is less familiar as a feature of ranges that border broad intermont plains.

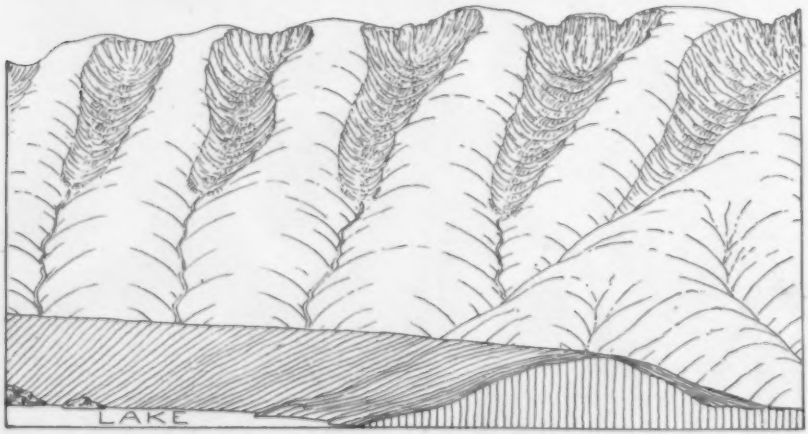

FIG. 10—Larger cirques: the moraine curves westward.

Yet another example of such truncation occurs not far away to the northeast, where the flanks of the Galton and Swan Ranges, the former far northward and the latter for some ten or fifteen miles south of the deep notch by which the Great Northern Railway enters the mountains from the broad intermont depression a short distance east of Columbia Falls station, bear conspicuous marks of scouring by the broad Canadian glacier, similar to but larger than those left upon the flanks of the Mission Range. Near the railway notch the terminal facets of the truncated spurs may well rise a thousand feet over the plain; but they rapidly decrease in height southward, and, beyond the last and lowest one, many other spurs trail away with long concave slopes into the intermont plain: it therefore appears that the farthest effect of the Canadian glacier along the mountain base is seen in the last spur-end facet.

The High Southern Belt. Several miles before the long morainic embankment turns west from the base of the Mission Range at the southern end of the low northern belt, the valley heads show cirque-like enlargement, as in Figures 8 and 9, and thus define the beginning of the third, or high southern belt. Unlike the other two belts, in each of which the sculpture is all of one kind—all normal sculpture in the middle belt, all glacial sculpture in the northern belt—the features of the southern belt are of two kinds, normal and glacial; but here the features of glacial sculpture are the work of separate local glaciers, each in its own valley, and the resulting cirques and troughs alternate with summits and spurs of normal erosion. The first cirque—see Figure 8—is so faintly developed that, were it seen alone, one might remain uncertain as to its nature; but there can be no doubt as to

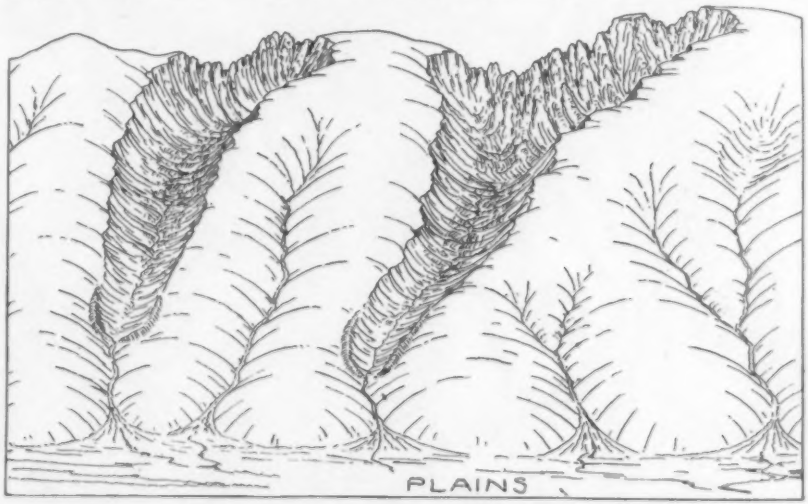

FIG. 11—Sharpened crests between opposing cirques.

its being the slight enlargement of a normal valley head by a small local glacier when it is seen as the northernmost recognizable member of a systematic series of twenty-five or more, of which the southernmost (Fig. 13) is a huge cliff-rimmed excavation in the mountain top, at least 1,000 feet deep, opening into a great rock-walled, hollow-floored trough that descends 5,000 feet to the mountain foot, where it is looped around by a beautiful though small terminal moraine. A line drawn through the lower end of all the troughs separates the middle belt from the high southern belt.

The normal features of the southern belt differ from those of the middle belt only in size and in completeness of development. They are large enough to extend through the entire height of the mountain side. Some of the spurs are subdivided by valleys of normal form that head at half or three-quarters mountain height, and therefore too low for the development

of cirques at their head; but other spurs continue undivided from mountain crest to mountain base. With increase of summit height southward, the spurs are more and more encroached upon by the intervening cirques and troughs, but the two classes of forms do not blend; they are separated by well-defined edges where the convex, waste-covered, normal form is suddenly undercut by the steep rock wall of the glacial excavation. The close association in which the two classes of forms are here seen adds force to the objections that I have elsewhere urged[5] against the empirical German phrase-words *Mittelgebirgsformen* and *Hochgebirgsformen*—that is, forms of middle-height mountains and of high mountains—as designations for features of the two classes which are here so intimately associated at the same

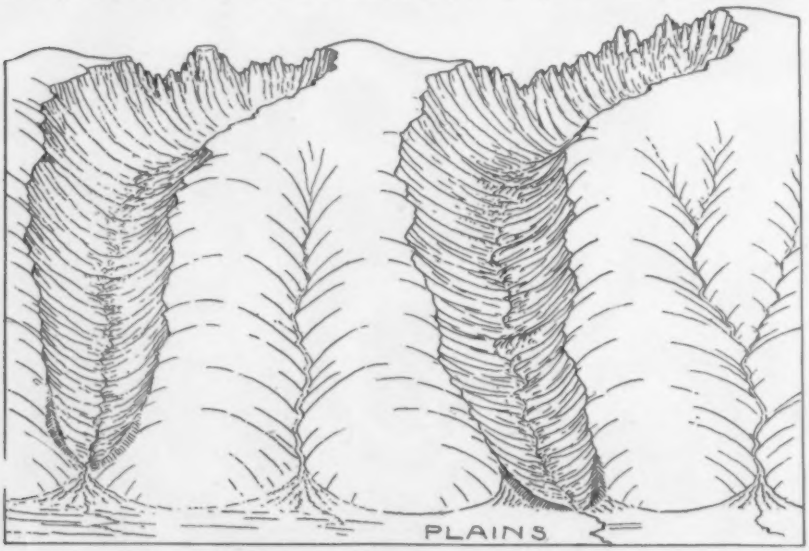

FIG. 12—The cirques are enlarged southward.

altitude; and the confidence with which the two classes are here distinguished gives renewed warrant for preferring explanatory phrases, like forms of normal and of glacial sculpture, to empirical phrases, such as round-topped and sharp-crested mountains.

Cirques and Troughs of Local Glaciers. It has surprised me on various earlier occasions to note the ease with which high-standing cirques can be made out at distances of several miles; from five to twenty miles in the Wasatch Range in Utah[6] and in the Front Range of Colorado,[7] from thirty to forty miles with a field glass in the higher ranges of Turkestan[8]; but

[5] Die erklärende Beschreibung der Landformen, Teubner, Leipzig, 1912, p. 286.

[6] The Wasatch, Canyon, and House Ranges, Utah, *Bull. Mus. Comp. Zool.*, Vol. 49, 1905, pp. 15-58; reference on p. 22.

[7] The Colorado Front Range, *Annals Assoc. Amer. Geogrs.*, Vol. 1, 1912, pp. 21-83; reference on p. 56.

[8] A Journey in Turkestan, pp. 23-119 (reference on p. 91) in R. Pumpelly's Explorations in Turkestan, *Carnegie Inst. Publ. No. 26*, Washington, 1905.

only in the Mission Range has the recognition of cirques at a distance been facilitated by their arrangement in a regularly progressive series of two dozen or more, in which larger and larger, stronger and stronger examples follow in regular procession through a stretch of forty miles. The series begins with smooth-contoured, valley-head hollows, perhaps a quarter mile in length and less in breadth, which, as above indicated, hardly deserve the name of cirques. As one's view is turned southward, the size of the hollows gradually increases, the head and side walls become steeper, with a greater exposure of base rock, as in Figure 9; farther on, as in Figure 10,

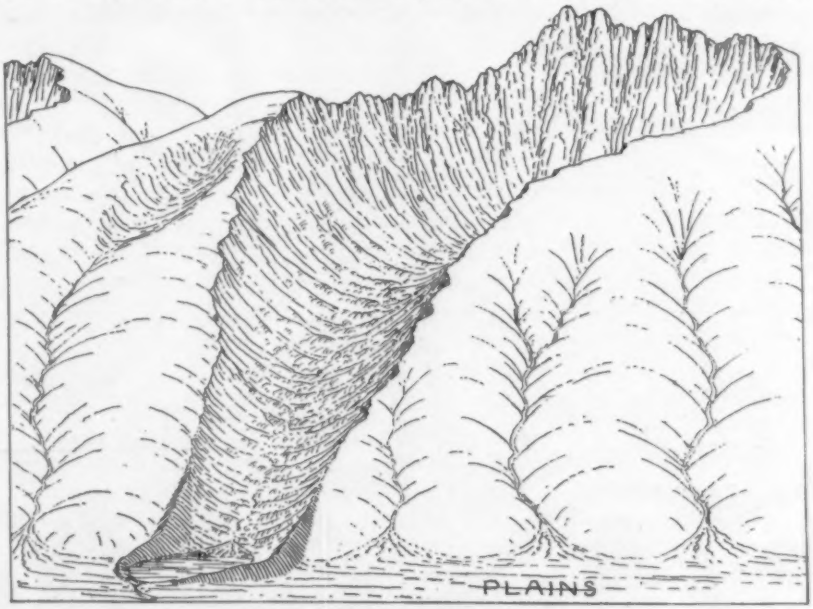

FIG. 13—An alpine crest and a piedmont lake.

the sky line of the head walls becomes notched, as if two opposing cirques had eaten through the convex crest of the mountain and locally converted it into a sharp and ragged edge, the beginning of maturity in glacial erosion of this kind; at the same time the troughs increase in length. These features characterize the parts of the range shown in Figures 15 and 17, looking across the plains south of Flathead Lake to the east and southeast. As the range increases in height a tendency is noted to the enlargement of the cirques southward, as if in exemplification of the rule that glaciers are best developed on shaded slopes[9]; and as the enlargement becomes more pronounced an extension of the maturely sharpened sky line is perceived through a greater length of mountain crest, as in Figures 11 and 12;

[9] G. K. Gilbert: Systematic Asymmetry of Crest Lines on the High Sierras of California, *Journ. of Geol.*, Vol. 12, 1904, pp. 579-588.

here the Alpine term, arête, may be well applied. With the fuller development of the cirques, the troughs gain strongly oversteepened walls and increase so greatly in length as to extend far down toward the foot of the range. The oversteepened walls have, as above noted, a sharply defined edge where they undercut the convex spurs; the bare rock, here and in the cirques exposed to free attack of the weather, is assuming minutely irregular forms and furnishing detritus to talus slopes and fans that are invading the rock floors below, but as far as I could see the change thus accomplished is small as yet. The emphatic definition of the mature cirques is strikingly unlike the vague limitation of the mature normal valley heads, and the acute

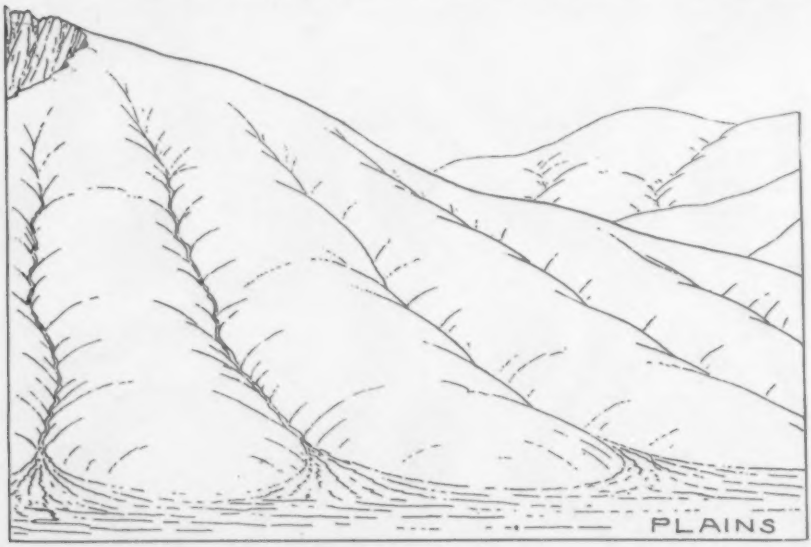

FIG. 14—Normal forms at the southern end of the range.

edge of mature arêtes, where only a narrow belt is exposed to weathering, is strikingly unlike the ample arch of the normally rounded mountain crest, where a broad belt is exposed to weathering; but both these unlikenesses are expectable in view of the fact that a mature glacier is of greatest size close to its high-level source, while a mature stream at its source is of smallest size. The broadly concave form of the troughs is strongly contrasted with the narrow concave of the normal valleys, and this contrast is intensified when one realizes that the proper homology of the large-featured glacial troughs is really found in the minute stream channels that are entrenched within the narrow valley concaves. Here one may realize the contrast between the sluggishness of a heavy glacier that nearly fills its wide and deep trough and the nimbleness of a slender stream that carries away all the ice water in a minute channel; here one may recall the comparison between mountain-

side glaciers, which in a temperate climate dwindle and disappear as they creep from snowy reservoirs down into a milder zone, with mountain-side streams, which in an arid climate wither and vanish as they run from the rainier summits down into the drier lower air.

Culmination of the Range. With continued increase in range heights, the southward enlargement of the cirques becomes so great that from a front view a large part of their interior is hidden, as in Figure 12. Finally, at the slowly attained culmination of the range close to its southern end, the largest and last cirque of the entire series is a formidable cavity, excavated half a mile or more southward of its discharging trough; and a small glacier is reported as lying concealed in the cirque head. Here the highest cirque wall, a great mass of bare rock, rises to an acutely serrate crest, forming in Mt. McDonald, 9,800 feet altitude, the loftiest peak of the range, near which the views reproduced in Figures 19, 20, and 21 were taken. The sky line of Figure 19 illustrates the simple crest of the range where it is not narrowed and notched between encroaching cirques, while the great rock face in the same view gives warrant for the steepness and ruggedness of the cirque and trough walls, as shown in the diagrammatic figures. The floor of the McDonald cirque is not in sight from the plain. The trough is a huge channel, rock-walled and rock-floored, with a fairly mature cross-section of catenary pattern. On either side the rounded spurs of normal sculpture are as typically convex as the trough is concave. The hollowed trough floor is not yet much encumbered, as far as I could determine, with talus fans; its longitudinal profile is somewhat broken by rock sills; whether rock basins occur also I could not see. The dimensions of the trough decrease as it descends the mountain side, but it is still well developed to the very foot of the range, where it is extended on the piedmont plain in the form of a terminal basin, rimmed by a well-formed terminal moraine. Farther to the south only normal forms (Fig. 14) are seen as the range rapidly declines toward the Jocko River in a long sunny slope.

The last member in the long succession of forms due to the local action of single glaciers is a fully developed example, beyond which an increase in size is possible but not an increase in completeness of detail; for between the cirque walls which rise to sharpened peaks and the trough which ends at a piedmont moraine is included the whole range of features that a single local glacier can produce. When, in addition to the features due to local glaciation in the high southern belt, are added those due to general glaciation in the low northern belt and both are viewed in their suggestive contrast with the normal features of the middle belt, the Mission Range is seen to be highly flavored with the spice that comes from variety. The concise and systematic combination of these varied features makes the range, as far as I have seen and read, unique.

FIG. 15.

FIG. 16.

FIG. 15—Southern part of Mission Range across Mission Plains. (Photo by R. W. Stone.)—Continuous with Figure 17.

FIG. 16—A scoured island in Flathead Lake. (Photo by R. W. Stone.)

FIG. 17.

FIG. 18.

FIG. 17—Southern part of Mission Range across Mission Plains. (Photo by R. W. Stone.)—Continuous with Figure 15.

FIG. 18—Glacial troughs in Mission Range over Flathead Lake. (Photo by R. W. Stone.)

Cycles and Episodes of Glacial Erosion. Large as the McDonald cirque is, it does not represent the completion of a glacial attack upon a mountain mass; that demands a relatively rapid widening of the cirque floor and its slower lowering until the enclosing walls are consumed—the action of the weather on exposed surfaces here aiding the action of ice on covered surfaces—and the mountain mass is truncated; at the same time the thick-

FIG. 19 -Glaciers on Mission Range, southeast of Mt. McDonald. (Photo by C. D. Walcott.)

ness of the ice on the truncated surface should diminish by reason of lessening mountain height and consequently decreasing snowfall, until the thin and relatively inert glacial veneer almost or quite disappears, the glacial tongues descending from it shorten and vanish, and the truncated mass remains subject only to normal dissection by the retrogressive erosion of its flanks. Here the analogy with stream work in an arid climate may be again recalled; for just as the wearing down of a mountain in a temperate region diminishes the snowfall upon it, so when a mountain range in a desert lowland is worn down the rainfall upon its area will decrease, and eventually, when the range is reduced to low relief, its surface will be about as dry as the lowland around it and subject to further degradation rather by wind than by water action. It was, I believe, Tyndall who first fancifully suggested that deglaciation might be the result of loss of height by

glacial erosion;[10] it is now generally agreed that deglaciation was the result of climatic change. Thus two schemes of the life history of a glacier are suggested: one is the highly ideal scheme of a constant climate, during which an upraised mountain mass will, if at first high enough, be glaciated until it is worn so low that its snowfall is lessened and its glaciers disappear, as Tyndall imagined for the actual case of the Alps, and as is above outlined for a supposititious case; this involves a complete "cycle of glacial erosion",[11] in the same sense that the wearing down of an upraised mass by weather and water involves a complete cycle of normal erosion. The other scheme is the more expectable one of a variable climate, in which a mountain mass will be glaciated only as long as the snowfall is sufficient to form glaciers, as was the case with Pleistocene glaciation; glaciers were then extinguished long before their work was completed, and hence, thus limited, the "life history of a glacier" as presented by Russell[12] and the "cycle of mountain glaciation" as presented by Hobbs[13] include only a life history or cycle cut short by climatic change in its prime; that is, a mere episode of glaciation, in which only the earlier stages of a complete cycle, the earlier phases of a full life history are considered. In the Mission Range we evidently have to do only with an episode of glaciation due to climatic changes, introduced upon a mountain already well carved by normal erosion from its initial form; an episode that was closed long before the final stage of an uninterrupted cycle of glacial erosion was reached.

The Explanatory Description of Mountains. The Mission Range forms an admirable subject for close examination by a student of physical geography to whom camping and climbing are exhilarating and to whom the study of land forms is a specialty; all the better if he could go on from the forms to their climate and their inhabitants, and thus make himself a full-fledged geographer. The district is easily accessible; supply stations are abundant near the mountain base. The range is sufficiently separated from its neighbors to form a well-limited field of work. Its rocks, as far as I have learned, have neither paleontological content nor petrographical composition in such variety as to distract a would-be geographer into irrelevant geological complications. The varied physiographic features are developed with remarkable clearness; if accurately described and illustrated they might serve as standards, in terms of which other less simple ranges could be advantageously treated.

[10] Tyndall wrote: "Given the uplifted land, and we have a glacial epoch; let the ice work down the earth, every foot it sinks necessitates its own diminution; the glaciers shrink as the valleys deepen; and finally we have a state of things in which the ice has dwindled to limits which barely serve as a key to the stupendous operations of a by-gone glacial age. To account for a glacial epoch, then, we need not resort to the hard hypothesis of a change in the amount of solar emission, or of a change in the temperature of space traversed by our system. Elevations of the land, which would naturally accompany the cooling of the earth, are quite competent to account for such an epoch; and the ice itself, in the absence of any other agency, would be competent to destroy the conditions which gave it birth." (The Conformation of the Alps, *Philos. Mag.*, Vol. 24, 1862, pp. 169-173; see pp. 172-173.)

[11] See reference in footnote 3, p. 294.

[12] I. C. Russell: Glaciers of North America, Ginn, Boston, 1897, Chapter 10.

[13] W. H. Hobbs: The Cycle of Mountain Glaciation, *Geogr. Journ.*, Vol. 35, 1910, pp. 146-163 and 268-284.

FIG 20—Mission Range in vicinity of Mt. McDonald, from head of Swan River. (Photo by C. D. Walcott.)

FIG. 21—Mission Range in vicinity of Mt. McDonald, from ridge on north head of Swan River. Alt. 6,900 ft. (Photo by C. D. Walcott.)

A spirit of geographical adventure has encouraged me here to set forth the results of a mere reconnaissance; first, because so little is known geographically of the individual ranges of Montana that every contribution to their further description is desirable; again, because the appearance of an incomplete account of the Mission Range may hasten the production of a more thorough study; finally and chiefly, because incomplete as this account is, it has a value in showing that a systematic method of treating land forms is sometimes applicable in rapid work, where conservative geographers of the empirical school think it is inapplicable, their idea being that explanatory description must demand long and intensive study, and therefore cannot be based on brief inspection.

STUDIES IN ECONOMIC GEOGRAPHY*

By CHARLES REDWAY DRYER

(I) Definitions and Classifications

Introduction; basic definitions

In economic geography, lack of organization is at once a reproach and a handicap to the geographer. To remove both in some degree, especially the handicap, I have been led to devise and use a scheme of definitions and classifications, which is offered as tentative and at least workable. It is based upon the following thesis proposed by J. Russell Smith and restated by W. S. Tower:

"Economic geography is the description and interpretation of lands in terms of their usefulness to humanity. Its net result is the understanding of the relationship between the people of a district and their physical environment."[1]

"Economic geography is the study of the different types of environments in the relations they bear to the activities of human life."[2]

These definitions do not err upon the side of being too narrow and are open to the objection of including the whole of anthropogeography. They are unquestionably geographical and stress a relationship between a physical complex and a human complex. The physical complex is called an environment, and convenience calls for an equally simple term to designate the human complex. For that purpose I use the word *economy*, which I define as a way or method by which living creatures, especially men, get or may get a living. Conversely, an *environment* is that part of the face of the earth with which living creatures, especially men, taken singly or in groups, are closely related in the process of getting a living. Using these terms to express the idea of Smith and Tower, *economic geography* is that part of anthropogeography which studies the relationships between environments and economies and deals with natural resources, industries, and the distribution of useful products.

Industrial geography is that part of economic geography which deals with the work by which useful products are obtained and manufactured.

Commercial geography is that part of economic geography which deals with the exchange of goods.

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* Read at the twelfth annual meeting of the Association of American Geographers, Washington, D.C., December 30-31, 1915, and January 1, 1916.

[1] J. Russell Smith: Economic Geography and Its Relation to Economic Theory and Higher Education, *Bull. Amer. Geogr. Soc.*, Vol. 39, 1907, pp. 472-481; reference on p. 475.

[2] W. S. Tower: Scientific Geography: The Relation of Its Content to Its Subdivisions, *Bull. Amer. Geogr. Soc.*, Vol. 42, 1910, pp. 801-825; reference on p. 818.

The large factors to be dealt with in economic geography fall into two categories, environments, which are fundamentally physical, and economies, which are largely psychical, and each demands rational classification.

CLASSIFICATION OF ENVIRONMENTS

The character of an environment is determined by a complex of pedographic,[3] hydrographic, climatic, phytographic, and zoögraphic conditions combined in vast variety. As I have argued at length elsewhere,[4] the general resultant of environmental conditions is best expressed in terms of phytography, because the vegetation of a region is an index (1) of its relief, soil, and climate, and (2) of its fitness to support animal and human life. Therefore environments may be broadly classified according to vegetation and subdivided according to other conditions which impose upon them locally a special character. This is shown in Table I.

TABLE I—CLASSIFICATION OF ENVIRONMENTS

	TYPICAL ECONOMIES (Notation of Table II)		TYPICAL ECONOMIES (Notation of Table II)
A GENERAL CONDITIONS		B SPECIAL CONDITIONS	
I Phytographic		II Morphologic	
a Woodland		13 Mountains	4, 5, 6, V
1 Tropical Rain Forest	1, 2, 3, 4	14 Plains	B, C, D
2 Monsoon Forest	1, 2, 3, 4, 7	III Regolithic *	
3 Temperate Rain Forest	9, 10, 11, 12	15 Alluvial	III, IV
4 Temperate Summer Forest	13, 14, 15	16 Glacial	
5 Coniferous Forest	2, 3, 4, 12	IV Marine	
6 Tropical Dry Forest	7, 8, 9	17 Interior	D
	11, 14	18 Coastal	
b Grassland		19 Peninsular	
7 Savanna	3, 7, 14	V Mineral	
8 Prairie	9, 14, 15	21 Coal	5, 6, C
9 Steppe	14	22 Iron	
10 Tundra	3, 14	23 Gold	
c Desert		etc.	
11 Warm Desert	7, 14		
12 Cold Desert	2, 3		

* ῥήγος, a rug, a blanket: i.e. "blanket-rock" (F. J. H. Merrill).

CLASSIFICATION OF ECONOMIES

A classification of economies, based in part upon Friedrich's "Wirtschaftsgeographie"[5] is shown in Table II. The letters and numbers of the tables furnish a notation by which they can be correlated.

[3] πέδον, the ground, the soil.

[4] Regional Geography, *Journ. of Geogr.*, Vol. 11, 1912-13, pp. 73-75, reference on p. 74; The New Departure in Geography, *ibid.*, Vol. 11, 1912-13, pp. 145-151 and 177-180, reference on p. 178.

[5] Ernst Friedrich: Allgemeine und spezielle Wirtschaftsgeographie, 2nd edit., Göschen, Leipzig, 1907.

TABLE II—CLASSIFICATION OF ECONOMIES

	TYPICAL ENVIRONMENTS (Notation of Table I)
A COLLECTIVE	
I Primitive	
1 Plucking	1, 2
2 Fishing	1, 2, 5, 12, 18, 19, 20,
3 Hunting	3, 4, 5, 7, 8, 12, 13
II Scientific	
4 Lumbering	3, 4, 5
5 Mining	13, 21, 22
6 Quarrying	.....
B PRODUCTIVE	
III Agriculture	
7 Hoe Culture	1, 2, 7, 11
8 Garden Culture	2, 6, 15
9 Field Culture	3, 4, 8, 14, 15, 16
10 Plantation Culture	2, 3, 7
11 Horticulture	.....
12 Forestry	4, 5
13 Plant Breeding	.....
IV Animal Industry	
14 Herding	9, 10, 11
15 Stock breeding	.....
C CONSTRUCTIVE	
V Manufacturing	13, 21, 22
VI Building	.....
VII Engineering	.....
16 Mechanical	.....
17 Chemical	.....
18 Architectural	.....
19 Hydraulic	.....
20 Naval	.....
21 Mining	.....
22 Military	.....
23 Civil	.....
24 Sanitary	.....
D DISTRIBUTIVE	14, 18, 19, 20
VIII Commerce	.....
IX Finance	.....
X Transportation	.....
XI Communication	.....
E PERSONAL	
XII Domestic Service	.....
XIII Professional Service	.....
25 Medical	.....
26 Legal	.....
27 Political	.....
28 Educational	.....
29 Literary	.....
30 Artistic	.....
31 Religious	.....
32 Military	.....

CLASSIFICATION OF ECONOMIC SOCIETIES

It is desirable to take account not only of environments and economies but also of their grand product and resultant, economic societies. They may be graded like organisms, according to their complexity and efficiency in the utilization of the environment. The following scheme is substantially that of Herbertson,[6] in which, however, I have made some important modifications. See Table III.

TABLE III—CLASSIFICATION OF ECONOMIC SOCIETIES

A SIMPLE, OR AUTARKEAN,* SOCIETIES (independent, self-supporting, nomadic, sparse)	B COMPLEX, OR ALLELARKEAN,† SOCIETIES (interdependent, fixed, dense, civilized)
1 Collective	4 Productive
2 Hoe Cultural	5 Productive and Distributive
3 Pastoral	6 Constructive and Distributive
	7 Productive, Constructive, and Distributive (potentially self-supporting, practically dependent)

* *χώρα αὐταρκής*, a country that supplies itself (Thucydides).
† *ἀλλήλων ἀρκεω*, of use to one another.

(A) *Simple Societies* depend upon the resources of their immediate environment, which are either meager or imperfectly utilized. Their wants

[6] A. J. Herbertson: A Handbook of Geography, 2 vols., Nelson, London, 1911-12; reference in Vol. 1, pp. 123-129.

are few and their industries rudimentary. Foreign trade is insignificant. They are independent, self-supporting, and usually nomadic. The density of population rarely rises to one to the square mile.

There are three types of prevailing economy:

(1) *Collective.* These are societies which by plucking, fishing, and hunting use and destroy natural resources, producing nothing. They inhabit the extremes of the world, cold deserts, tundras, coniferous forests, tropical forests, and coastal and insular environments in all zones.

(2) *Hoe Cultural.* These are societies which combine hoe culture with collective economy and herding. They occupy savannas, tropical islands, and the margins of warm deserts and forests. Their population is more dense than that of other simple societies.

(3) *Pastoral.* These are societies whose main resource is grass and domestic animals. They inhabit steppes, savannas, and tundras.

(B) *Complex Societies* depend upon other societies to supply a large part of their wants, which are numerous and varied. Foreign commerce is essential. The resources of their own environment are exploited and sometimes fully utilized, and industries are moderately to highly developed. They are interdependent upon one another. While their homes are fixed, they are individually the most nomadic of peoples. They flourish in the temperate forests and grasslands but are extending their economies and crowding on and out all simpler societies. There are four types:

(4) *Productive.* These are societies which produce foodstuffs and raw materials at home and obtain limited manufactures by trade. Their density may be very high. The best examples are to be found in China and India.

(5) *Productive and Distributive.* These are societies which export a large part of their foodstuffs and raw materials and import corresponding values of manufactured goods. When agricultural, they have a large excess of rural over urban population. They are young and sparsely populated countries, in many cases colonial. Australia, South Africa, and Argentina are examples. They are complementary to and dependent upon those of the next type.

(6) *Constructive and Distributive.* These are societies which import most of their foodstuffs and raw materials and export manufactures. They live chiefly on coal and iron and are very wealthy, but their resources are exhaustible. A coastal or insular environment is essential. The density of population is high with a large excess of urban. Great Britain and Belgium are the leading examples.

(7) *Productive, Constructive, and Distributive.* These are societies which export and import foodstuffs, raw materials, and manufactures. They practice all economies and exploit all kinds of resources. Commerce is extensive and varied. Rural and urban populations are nearly balanced. They might be self-supporting but actually enjoy all the resources and products of the world. Their wealth is capable of indefinite increase.

These, the most complex of societies, are possible only in highly complex environments. Of such the United States is, far and away, the best example. The only environment comparable with the American is the Russian, but many of its economies are undeveloped. On a small scale, France and Germany belong to the same class. To the latter must be awarded the palm for thoroughness and completeness in the utilization of an environment in many respects inferior.

REFLECTIONS

Environments are as stable and enduring as other large features of nature; economies are subject to the vicissitudes of human history. Consequently they may be extinct, kinetic, or potential. The environment of Mesopotamia has remained essentially the same since Adam and Eve dwelt in the Garden of Eden. The intensive agriculture of the Chaldeans and Babylonians, almost extinct under the Turks, is still potential and may become again kinetic under British or German influence. The Chinese environment has changed only by the removal of forests, and Chinese economy has proved the most enduring now in existence. It would be difficult to show how the environments of North America have changed in any important particular in the last thousand years, but the collective economy of the Indian has been displaced by the highly complex economy of the Americans, which was potentially present in pre-Columbian times. The economies of half the world are still potential.

People are civilized in proportion as they adapt themselves to a large and varied environment and to the complexity of their economy.

(II) The Economic Regions of the United States

In extent and complexity the United States is comparable with the whole of Europe. To deal with it from the standpoint of economic geography it is necessary to divide it into economic regions, based on differences of natural environment. The imperative, primary division is into east and west; the one, low, smooth, humid, and Atlantic; the other, high, rough, arid, and Pacific. The dividing line is a delightfully critical one, where the isohypse of 2,000 feet and the isopleth of 20 inches nearly coincide with the median meridian of 100° W. The large physiographic and climatic features trend north and south and vary east and west. My scheme of subdivisions is shown on the map, Figure 1, where, for statistical and other obvious reasons, state boundaries are used. Each border state is included in the region where its principal economies place it, and the resulting discrepancies are not very serious.

THE MIDDLE WEST

The economic foundation, core, and center of gravity of the country is the Middle West. It has an almost ideal allotment of coniferous forest,

summer forest, and prairie, passing into steppe on the west. Two-thirds of it is a plain of glacial drift. There are no mountains, few hills, and dissected uplands occur only in the southeast and southwest. It is far inland, but the Laurentian lakes, with their connecting rivers and canals, give the region an almost coastal character. Coal, iron, and copper are abundant and conveniently located. The region is lacking in no prime resource except water power.

The economies of the Middle West are developed to an extent which makes it the granary, smoke-house, cellar, and pantry of the American homestead. Constructive economies are not far behind productive, and dis-

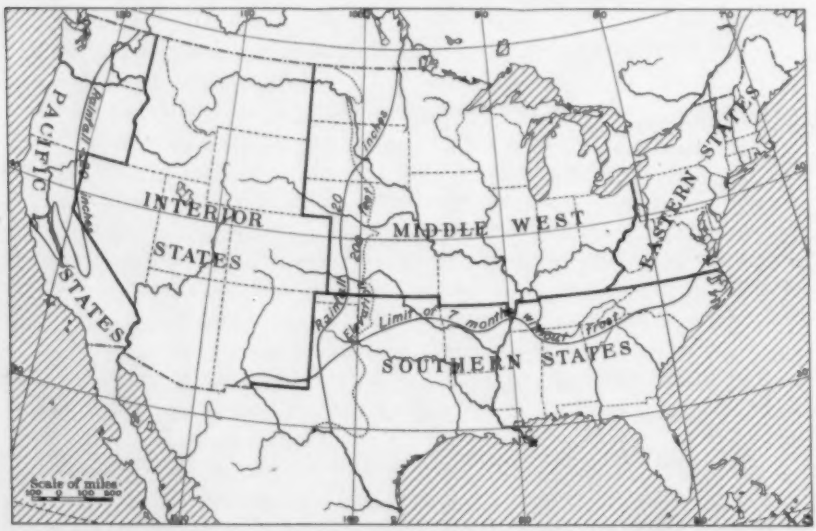

FIG. 1—Map of the economic regions of the United States as used in the present paper. Scale, 1:40,000,000. (*Note*: On the dotted line indicating elevation near the 100th meridian, for "200 feet" read 2,000 feet.)

tribution is as easy and active as is possible anywhere on land. The lines in which the Middle West takes a high rank are shown in Table IV, standing being expressed in percentages of the total for the United States.

To summarize the table, the Middle West has approximately one-fourth the area, one-third the population, one-half the improved land and two-fifths of the railroad mileage of the United States. It furnishes 70 per cent of the grain and meat, 60 per cent of the butter, cheese, and flour, 50 per cent of the potatoes, hay, tobacco, and domestic animals, 85 per cent of the iron ore, and 30 per cent of all minerals. It manufactures 70 per cent of the agricultural implements, vehicles, and distilled spirits, 50 per cent of clay products, 40 per cent of foundry products, cement, and soap, 35 per cent of iron and steel and printed matter, and 35 per cent of all manufactures. Its total wealth calculated in several different ways is about 40 per

TABLE IV—LEADING ECONOMIC FACTORS OF THE MIDDLE WEST

	YEAR	PER-CENTAGE OF TOTAL FOR U.S.		YEAR	PER-CENTAGE OF TOTAL FOR U.S.
Land area	....	27	Iron ore (tons)	1913	85
Population	1910	35	Zinc (tons)	1913	52
Improved land	1910	58	Clay products (value)	1913	49
Rural population	1910	57*	Cement (value)	1913	40
Corn (bushels)	1912	71	All minerals (value)	1913	29
Wheat (bushels)	1913	70	Agricultural implements (value)	1909	79
Oats (bushels)	1912	80	Meat (value)	1909	70
Barley (bushels)	1912	68	Automobiles (value)	1909	73
Rye (bushels)	1913	65	Carriages and wagons (value)	1909	63
Tobacco (pounds)	1912	52	Distilled spirits (gallons)	1913	69
Potatoes (bushels)	1912	50	Butter and cheese (value)	1909	63
Hay (tons)	1912	48	Flour (value)	1909	60
Swine (number)	1912	64	Fermented liquors (barrels)	1913	44
Horses (number)	1912	50	Pig iron (tons)	1913	39
Milch cows (number)	1912	51	Pig iron (value)	1909	34
Neat cattle (number)	1912	42	Steel (value)	1909	36
Animals sold and slaughtered (value)	1909	52	All manufactures (value)	1909	35
Fowls and eggs (value)	1909	54	Railroad mileage	1913	40
Dairy products (value)	1909	47	Natural wealth produced	1909–10	48
All animal products (value)	1909	60	Net wealth produced	1909–10	43
All crops (value)	1909	49	Total wealth	1912	39
All farm products (value)	1909	53			
Farm property (value)	1909	60			

* Per cent of region.

cent of the total of the United States and greater than that of any other region. Its environment is the best in America and one of the best in the world. Nowhere else are the productive, constructive, and distributive economies more happily combined. As an economic unit, it is an epitome of the whole country and a particularly young and vigorous specimen of the highest class of economic societies.

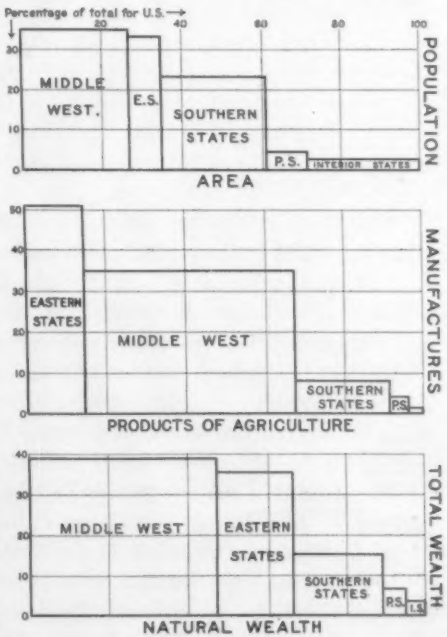

FIG. 2—Diagram showing the economic rank of the five economic regions of the United States.

THE EASTERN STATES

The Eastern States are characterized by generally rough relief, with a narrow coastal plain and narrower lake plain. The environment is mildly mountainous and strongly coastal. Its coniferous and summer forests have been important in the past. Rough relief, inferior soils, and lack of plains and prairies are handicaps to agriculture. Water power, vast stores of anthracite and bituminous coal, and the Atlantic coast line, with its numerous tidal inlets, are

controlling factors. The vital importance of the Laurentian gap, giving access to the food supplies and iron ore of the Middle West, can hardly be overestimated. While field culture, gardening, horticulture, and dairying are not negligible, the region is marked out by nature as the seat of manufacture and commerce. With a start of two centuries ahead of the rest of the country and with Europe close by to furnish an unlimited supply of cheap labor, the result is as natural as the march of the day from sunrise to noon. The economic rank of the Eastern States in their leading lines is shown in Table V.

TABLE V—LEADING ECONOMIC FACTORS OF THE EASTERN STATES

	YEAR	PER-CENTAGE OF TOTAL FOR U.S.		YEAR	PER-CENTAGE OF TOTAL FOR U.S.
Land area	....	8	Ship building (value)	1909	60
Population	1910	33	Paint and varnish (value)	1909	49
Urban population	1910	67*	Fermented liquors (gallons)	1914	48
Of foreign parentage	1910	53*	Printing and publishing (value)	1909	52
Employed in manufacture	1910	40*	Foundry & mach. shop products (val.)	1909	50
Silk (value)	1909	97	All manufactures (value)	1909	51
Woolen goods (value)	1909	95	Coal (value)	1913	60
Dyeing and finishing (value)	1909	92	Natural gas (value)	1913	66
Carpets and rugs (value)	1909	92	Stone (value)	1913	47
Hosiery and knit goods (value)	1909	78	Cement (value)	1913	40
Cordage and twine (value)	1909	74	All minerals (value)	1913	37
Clothing (value)	1909	72	Apples (bushels)	1914	49
Cotton goods (value)	1909	63	Dairy products (value)	1909	34
Boots and shoes (value)	1909	73	Orchard fruits (value)	1909	31
Leather (value)	1909	65	Potatoes (bushels)	1912	31
Gloves and mittens (value)	1909	62	Hay (tons)	1912	26
Paper and wood pulp (value)	1909	70	Tobacco (pounds)	1912	26
Electrical machinery (value)	1909	70	All farm products (value)	1909	15
Chemicals (value)	1909	69	Railroad mileage	1913	17
Glass (value)	1909	58	Foreign commerce	1913-14	64
Steel (value)	1909	60	Imports	1913-14	77
Pig iron (value)	1909	51	Total wealth	1912	35
Pig iron (tons)	1913	50			

* Per cent of region.

The Eastern States, with one-twelfth the area of the United States, have one-third the population, 67 per cent of which is urban and 53 per cent of foreign parentage. Their manufacture of textiles ranges from 63 per cent of cotton goods to 97 per cent of silk. They make 70 per cent of the leather, leather goods, and clothing, 60 per cent of steel and glass, 55 per cent of paper, chemicals, and electrical machinery, 50 per cent of pig iron, foundry products, soap, fermented liquors, paint and varnish, build 60 per cent of the ships, do more than half the printing and publishing, and turn out more than half the value of all manufactures. They mine 60 per cent of the coal, 66 per cent of the natural gas, and 38 per cent of all minerals. With 16 per cent of the railroad mileage, they have 64 per cent of the foreign commerce and 77 per cent of the imports.

They contain the leading seaport and the second largest city in the world, which has a real estate valuation greater than that of all the wealth of the western half of the United States. This accumulation may be regarded as profits derived from the elaboration and exchange of the

products of the Middle West. The total wealth of the Eastern States is about 35 per cent of that of the United States and is second only to that of the Middle West. They belong to the constructive and distributive class of economic societies, are already a formidable rival of Great Britain for first place in that class, and the end is not yet.

THE SOUTHERN STATES

The Southern States look on the map as if they had been shorn as mercilessly as some of the European countries will be at the close of the present war. But in economic geography, political and social prejudices do not count in the face of natural and economic conditions. Geographically, the Southern States are bounded on the north by the limit of seven months without frost and are distinguished as being the realm of King Cotton. More than half their area is coastal plain, occupied largely by an anomalous coniferous forest in the warm temperate zone, where, according to rule, a temperate rain and summer forest belongs. The Appalachian Highland thrusts its salutary bulk into the plain, and the wide, alluvial valley of the lower Mississippi cuts it in two. In the west the body of the giant among states extends well into the arid plateaus. The long coast line on the Atlantic and on the American Mediterranean has failed, largely on account of shallow coast waters, to produce an adequate response. In the days of slavery the economy of the Southern States was singularly simple, artless, successful, and, in the long run, suicidal. Cotton was grown on shifting plantations and exchanged in raw bulk for almost everything else. This one-crop agriculture persists and is still the bane of Southern economy. Citrus fruits, sugar cane, and rice flourish in strictly limited areas and introduce local variations of the one-crop system. The boll weevil and the European war may prove efficient blessings by breaking up the one-crop system and compelling the people to raise at least corn and cattle enough to feed themselves.

Manufacturing has grown to relatively large proportions but is still based on cotton. The water power of the Highland has been harnessed to a network of hydro-electric power transmission said to be the most extensive in the world. Iron and coal in Alabama and petroleum in Oklahoma, Texas, and Louisiana induce local eruptions of collective and constructive activity. The coniferous and hardwood forests of the South are proving a widow's cruse and saving the Middle West and the Eastern States from a timber famine.

After all this is said, it remains to say that the Southern States are the most strongly agricultural region in the country, with a rural population of 80 per cent, 60 per cent of employed persons on the land and only 2 per cent foreign born. What the Panama Canal will do to them may be only conjectured, but their opportunities for commerce are beyond calculation.

TABLE VI—LEADING ECONOMIC FACTORS OF THE SOUTHERN STATES

	YEAR	PER-CENTAGE OF TOTAL FOR U.S.		YEAR	PER-CENTAGE OF TOTAL FOR U.S.
Land area	....	26	All farm products (value)	1909	24
Population	1910	24	Fertilizers (value)	1909	48
Rural population	1910	81*	Cotton goods (value)	1909	35
White population	1910	66*	All manufactures (value)	1909	8
Foreign born	1910	2*	Petroleum (value)	1913	36
Employed on land	1910	59*	All minerals (value)	1913	10
Cotton (bales)	1911	99	Timber and lumber (feet)	1913	47
Rice (bushels)	1913	99	Railroad mileage	1913	27
Oranges (value)	1909	26	Foreign commerce	1913-14	27
Mules (number)	1909	65	Exports	1913-14	31
Neat cattle (number)	1909	30	Natural wealth produced	1909-10	23
Improved land	1910	24	Total wealth	1912	15

* Per cent of region.

The Southern States have approximately one-fourth the area and population of the United States. They raise practically all the cotton and rice and 65 per cent of the mules. Neat cattle, mostly in Texas, amount to 30 per cent, oranges to 26 per cent, corn and tobacco to 22 per cent, and all crops to 29 per cent. Their only notable manufactures are cotton goods, 35 per cent, and fertilizers, 48 per cent. They cut 47 per cent of the timber and lumber and have 27 per cent of the railway mileage. Their foreign commerce is 21 per cent, in exports 31 per cent. Their total wealth cannot be rated higher than 16 per cent and is the lowest per capita in the United States. The Southern States are on their way out of an extreme Australian type of economy toward the higher type which their environment favors.

The western half of the United States seems to have been thrown in for good measure, heaped up, pressed down and running over. The best statistics now available give it a present value of about 10 per cent. Let us not hint that it is superfluous, but the question, What difference would it make if the Pacific Coast were east of the Rocky Mountains? might afford entertainment for the idle hour of a speculative geographer.

THE INTERIOR STATES

The Interior States are occupied by high, arid plateaus, and saved from desert conditions by a broad central backbone of lofty mountains, which act as a condenser and furnish water and impetus for streams which overcome all obstacles on their way to the Gulf and the Pacific. They almost touch the sea on the southwest, but have no ports or navigable rivers, except the Columbia. The mountain barrier on the west cuts them off from the softening and enriching influences of the Pacific, and the environment is one of mountains, steppe, and desert, which shade into one another with every degree of blending.

While the area is 29 per cent, the population is less than 3 per cent, with a density of three to the square mile. The 64 per cent of urban population

TABLE VII—LEADING ECONOMIC FACTORS OF THE INTERIOR STATES AND THE PACIFIC STATES

INTERIOR STATES	YEAR	PERCENTAGE OF TOTAL FOR U.S.	PACIFIC STATES	YEAR	PERCENTAGE OF TOTAL FOR U.S.
Land area	....	29	Land area	....	10
Population	1910	3	Population	1910	5
Urban population	1910	64*	Urban population	1910	57*
Silver (value)	1913	95	Foreign born	1910	23*
Copper (pounds)	1913	81	Oranges (value)	1909	74
Gold (value)	1913	69	Grapes (value)	1909	51
Lead (tons)	1913	62	Timber and lumber (feet)	1913	21
All minerals (value)	1913	16	Petroleum (barrels)	1913	39
Sheep (number)	1913	44	Petroleum (value)	1913	19
Wool (value)	1909	45	Gold (value)	1913	30
Neat cattle (number)	1913	14	Canning and preserving	1909	29
Railroad mileage	1913	10	Railroad mileage	1913	6
Total wealth	1912	4	Foreign commerce	1913–14	6
			Total wealth	1912	7

* Per cent of region.

does not mean large cities, but is an index of general sparseness. Crops and manufactures are relatively negligible. While herding is the most general economy, cattle amount to only 15 per cent. The only large figures are 44 per cent for sheep and 45 per cent for wool. Nearly 10 per cent of the employed are miners. The region produces 95 per cent of the silver, 81 per cent of the copper, 69 per cent of the gold, 62 per cent of the lead and 38 per cent of the zinc, but the total minerals amount to only 16 per cent. The steppe is being invaded by dry farming and the desert by irrigation. The total wealth is about 3.5 per cent, but is higher per capita than in the Middle West. Among invaluable riches not subject to appraisal are sanitary air, scenery, geological sections and fossils.

The Interior States are in an unstable and transitional stage of economic development. The value of crops now exceeds that of cattle and sheep. Water power is the only resource which can ever lift them out of a low rank among complex economic societies and make them more than tributary and supplemental to their richer neighbors. Perhaps they are worth the space they occupy as the home of the traditional Indian and cowboy, as a tuberculosis hospital, and as a field for desert botanical laboratories, university scientific excursions, and the promotion of railway engineering.

THE PACIFIC STATES

The Pacific States are a land of contrasts, where the highest and the lowest, the driest and the wettest, the hottest and the most temperate, bare desert and impenetrable forest occur in proximity. The sea, desert, palm groves, mountains, fir forests, and summer snows are visible in the same landscape. The region is a narrow strip between the mountains and the sea, 1,200 miles long and 300 miles wide, in which all sorts of gradients are steeper crosswise than lengthwise. The phytographic environment

ranges from warm desert through tropical dry forest to coniferous forest. The large coastal factor is peculiar in being generally unavailable but possessing two of the most spacious harbors in the world and a great river mouth.

In grain crops and domestic animals their rank is low, but in semi-tropical fruits high, ranging from 51 per cent of grapes to 74 per cent of oranges and a monopoly of olives and figs. The leading minerals are petroleum, 40 per cent in quantity although but half that in value, and gold, 30 per cent. The only notable line of manufacture is canning and preserving, amounting to 30 per cent. The 20 per cent of timber and lumber now cut is but a sliver from the richest coniferous forest in the world. If the petroleum holds out, it will make up largely for the lack of coal, and, if it gives out, the mountain streams can furnish hydro-electric power sufficient for a dense manufacturing population. From the economic standpoint cheap labor is the one thing most needed. It knocks at the doors and almost batters them down but is denied admission. The most enduring natural assets of the Pacific States seem to lie in their unrivaled forests, Mediterranean climate, and the Pacific Ocean. Their foreign commerce is now 6 per cent, or a little less than that of the Middle West. The total wealth, about 7 per cent, is the highest per capita in the United States.

As an economic unit the region is difficult to classify, but seems to be a youthful and precocious specimen of the highest type, in which productive, constructive, and distributive economies will at maturity be highly developed. It is a rough and narrow strip with small hinterland, separated by a thousand miles of mountains and desert from the rich communities of the East, to which it is artificially tied. But it faces and must control the commerce of the Pacific, which is said to be the ocean of the future. If a recent economist[7] is right, the Panama Canal and petroleum fuel will make freight and passenger rates as low between San Francisco and Liverpool as between New York and Liverpool, the treasures of the Atlantic will be open, and the Pacific Coast will experience such a boom in immigration and commerce as the world has never seen. It is the big youngster of Uncle Sam's family, who is rapidly outgrowing the awkwardness and bluster of adolescence and promises to attain imposing proportions and dignity. Nevertheless, if I may claim the right of a mere geographer to indulge in scientific prophecy, I see no reason to withdraw the forecast, made on a previous occasion,[8] that "if there are ever as many people and as much wealth between Los Angeles and Prince Rupert as between Chesapeake Bay and the Gulf of St. Lawrence, it will be when San Francisco is the capital of Japanese or Chinese America."

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[7] R. L. Dunn, *Senate Doc. No. 540, 63d Congr., 2nd Session.*

[8] The North America of Today and Tomorrow and Indiana's Place in It, *Proc. Indiana Acad. of Science*, 1911, pp. 37-54; reference on p. 51.

GEOGRAPHICAL RECORD

AMERICAN GEOGRAPHICAL SOCIETY

Additions to the Society's Map Collection. A large number of British Admiralty charts were recently added to the map collection. They were selected in such a manner that with their acquisition all of the charted coasts of the world are now represented in the Society's series. It is proposed to increase this collection from time to time by adding the largest-scale charts of important regions. This will be done, in part, by means of U. S. Hydrographic Office charts, all the recently issued sheets of which have been purchased. Furthermore, the entire set of charts issued by this office for South American waters was recently purchased.

Pursuing its policy of maintaining an unbroken chronological sequence in the maps of a given region, the Society has lately added a number of photostatic copies of notable American maps to its collection. These reproductions have the same size as the originals and are quite convenient for working purposes. Among them are:

Augustin Hermann's Map of Virginia and Maryland, 1673
Captain John Smith's Map of Virginia and Maryland, 1608
Filson's Map of Kentucky, 1784
Bernard Roman's Map of Florida, 1774
John Fitch's Map of the Northwest, 1785
Thomas Pound's Map of New England, 1691
John With's Map of Virginia, 1585
The Vingboom Map of New York, 1639
The Des Barres Map of Penobscot Bay, 1776.

NORTH AMERICA

Further News of the Explorer Radford's Death. The death of Harry V. Radford, the explorer, at the hands of Eskimos on or about June 5, 1912, at Bathurst Inlet on the Arctic coast of Canada was noted in the *Bulletin of the American Geographical Society* for December, 1913 (pp. 924-925). This information was based on Eskimo reports to the Royal North West Mounted Police. As a consequence a party of five mounted policemen was sent out two years ago to apprehend the slayers. News has recently been received from Mr. John I. Inglis of Ottawa that the culpable Eskimos have not yet been found; the police, however, obtained important information which promises an early successful termination of the search. The first party is being relieved by a second party of mounted police which sailed from Montreal on August 9 for Hudson Bay. The most reliable information with regard to Radford's death was contained in a report from H. H. Hall, manager of the Hudson Bay Company's trading post at Chesterfield Inlet on the northwestern shore of the bay, a copy of which was sent to the Society and portions of which were published in the newspapers at the time Radford's will was probated in New York City, October 5, 1915. According to this report, the murder occurred just as the explorer was setting out on a sledge journey. One of the two local Eskimos who had been engaged for the journey had already started when the other refused to go. To enforce obedience, Radford struck him with the handle of a whip; a fight ensued and Radford was speared in the back by another native. T. George Street, Radford's white companion, made a run for the sledge to get a gun but was killed before he could reach it. From the story told Mr. Hall by his informant, a civilized Eskimo who had met members of the Bathurst Inlet tribe a few days later, it seems that the man refused to go because his wife had become suddenly ill. Radford was not familiar with the language of this tribe and must have misunderstood the man's meaning. Blows once dealt, the rest followed quickly, as, in their primitive state, these Eskimos generally settle quarrels and disputes with the death of one of the combatants.

References to the primitive state of this tribe are contained in a letter from Radford to this Society, dated June 5, 1912, the probable date of his death, in which he said: "We found a very primitive tribe of Eskimos inhabiting Bathurst Inlet, who have no intercourse with whites. They possess no rifles, and hunt, as of old, with the bow, spear, and harpoon; use stone kettles and knives of hammered native copper; and strike fire with stones and tinder, or by rubbing a pointed stick into another piece of wood until the latter becomes heated enough to ignite. They speak a dialect very

different from that of the inland Eskimos and those who dwell near Hudson Bay; and Mr. Street and I find it difficult to communicate with them."

Radford was thirty-one years old at the time of his death. He became a Life Fellow of this Society in 1908. In 1909 he set out upon the expedition on which he was engaged when he was killed. His main work was zoölogical, but he made it a point to maintain track surveys of his route, an undertaking in which his training as a civil engineer gave him proficiency. In this way he was able, in no inconsiderable degree, to rectify the maps of the regions he had traversed. His route lay from Lake Athabaska, down the Slave River to Great Slave Lake; thence northeast and eastward via Artillery Lake, the lower Thelon River, and Schultz and Baker Lakes to Chesterfield Inlet on Hudson Bay. From that place he traveled back, retracing his steps for part of the journey and then striking northwest until he reached Bathurst Inlet on the Arctic coast of Canada. There, shortly before his death, he surveyed the western coast of the inlet as far north as 67° 15′ N.; and it was his wish to complete the survey of this, "the last strip remaining unexplored of the continental coast of North America," as he himself expressed it. The completion of this gap, left open by the Franklin expedition in 1821, by the southern party of the Stefansson expedition was recently reported (see the September *Review*, p. 232). From Bathurst Inlet Radford had planned to continue west along the coast to the mouth of the Mackenzie and thence to Fort McPherson and Dawson, hoping to reach New York early in 1913.

A progressive account of his expedition, as reported in his letters to the Society, will be found in the *Bulletin of the American Geographical Society*, as follows: 1909, p. 624; 1911, pp. 134 and 777; 1912, pp. 46-47 and 600-601; 1913, pp. 134 and 924-925.

Exploration of the Region between Athabaska and Great Slave Lakes. In approximate figures 850,000 square miles or one-quarter of the total area of continental Canada is unexplored country. One of the largest of the unexplored "blocks" was the eastern portion of the territory between Lakes Athabaska and Great Slave. The Canadian Geological Survey now publishes the report of a reconnaissance made across it in 1914 (Charles Camsell: An Exploration of the Tazin and Taltson Rivers, North West Territories, *Geol. Survey of Canada Memoir 84*, Ottawa, 1916). Heretofore the only written record of the region was that by Samuel Hearne, who passed through in 1772 on his return journey from the successful trip to the Coppermine River. A new edition of his account, "A Journey from Prince of Wales Fort in Hudson's Bay to the Northern Ocean," was published in 1911 by the Champlain Society. Hearne's map and description have served practically all Canadian map makers until very recently. The newest maps, however, contain modifications and additions based on information from H. V. Radford, the explorer lately killed by Eskimos at Bathurst Inlet, to whom reference is made in the preceding item. It is not known whether he gained his material by personal experience or through Indian informants. King, who accompanied Back in his explorations of the early thirties, published an Indian route map and description followed in part by the Survey expedition.

The region, comprised largely by the basin of the Taltson River, is typical Laurentian Plateau country. Travel in summer is possible only by canoe. During the journey down the Taltson and Tazin Rivers the Survey party had to make forty portages and run "dozens of rapids." Bare rock surface exhibiting signs of intense glaciation is everywhere the characteristic feature. The only considerable area of sedimentary material is found towards the mouth of the Taltson River, which there cuts through an ancient delta of the Slave River. On the west the region borders the great highway to the Mackenzie, but its lack of natural resources have closed it to interest in the past and will probably continue to do so in the future. Timber is small and stunted; agriculture is precluded by the absence of soil; and, though the waters abound in fish, game is scarce save during the southward migration of the caribou. The mineral possibilities are unknown. The small Indian population belongs to two tribes of Athabaskan linguistic stock, the Caribou Eaters branch of the Chipewyans, and the Dogribs. The latter appear to have absorbed or dispossessed the former inhabitants, the Yellow Knives, or Copper Indians. The movements of this nomadic population embrace a summer visit to one or another of the trading posts, Fort Smith, Fond du Lac, Chipewyan, or Resolution for the receipt of the annual government grant; an autumn gathering about the headwaters of the Taltson to hunt the southward-migrating caribou on the southwestern fringe of the Barren Grounds; and a winter return to the trading posts at Christmas and Easter to take part in the religious festivals, for all the natives now belong to the Roman Catholic church.

Forest Fires and Conservation in the Ontario Clay Belt. In northern Ontario is a belt of country underlain by clay and marked by excessive moisture and a short growing season. The settlers have tried to reduce the moisture and lengthen the growing

season, at the same time that they cleared the land for agriculture, by burning the forest, especially along the line of the Temiskaming and Northern Ontario Railway. To this action the Canadian Forestry Association and others make protest. The fires spread to the "absolute" forest land, useless except for growing trees, and almost irreclaimable for forestry once the humus has been burnt out of the thin soil. The settler contends that the clay belt, one of the few extensive tracks of potentially arable soil in northern Ontario, should be cleared as soon as possible and at minimum cost for immediate crop purposes. Thus the lumberman and the farmer in this frontier region have conflicting interests strongly reminiscent of the differences in our own West between cattlemen and sheep herders. Investigation is under way, and the case of the clay belt soils and forests in relation to agriculture promises to have scientific treatment (Burning Off the Claybelt, *Canadian Forestry Journ.*, April, 1916, pp. 468-470. For a reference to the location and character of the clay belt see R. W. Brock: The Physical Basis of Canada, pp. 9-91 [ref. on p. 64] in Vol. 9 of "Canada and Its Provinces" edited by Adam Shortt and A. G. Doughty, Toronto, 1914.)

The Florida State Census and 1916 Map. Beginning in 1885 the state of Florida, like a few others, has taken a census every ten years, midway between the federal censuses. The report for 1885 is said to have been a very small affair, perhaps a single sheet, giving only the total population by counties. That for 1895 is a pamphlet of about fifty octavo pages. The third census, taken in 1905, covered population, agriculture, and manufactures, and its report, published jointly by the Secretary of State and the Commissioner of Agriculture, comprises 304 pages.

The report for 1915 was published about the middle of 1916, by the Commissioner of Agriculture, as an octavo pamphlet of 78 closely printed pages. It covers population only, crop statistics being given in recent years in the biennial reports of the agricultural department. It begins with a four-page sketch of the history of Florida and a condensed summary of changes in county boundaries from 1821 to date. The tables include population by counties at each census from 1830 to 1915; the same grouped by five more or less arbitrary divisions, with calculations of the percentage of whites, density of population, and rate of increase between censuses, for each division (this table mostly prepared by the undersigned while in Tallahassee last fall); population of counties by race, sex, and age, illiteracy, nativity, etc.; population of minor civil divisions by race and age groups; deaf, dumb, and blind persons and centenarians, by counties; and population of cities and towns, by race, with comparisons with two earlier censuses. The areas given for the counties correspond with those in the government census of 1900, except where there have been subsequent changes, and they are remarkably inaccurate in some cases.

The schedules used in 1915 called for no specific information about marital condition, and consequently no statistics on that point are given. Some of the data gathered were not utilized, perhaps for lack of funds, namely, the number of families, the months of birth, and the state or country in which each person and his parents were born, except that the native and foreign-born population are separated in two of the tables. (The government census of 1880 gave the population of each county in the United States by state and country of birth, but since then this interesting information does not seem to have been given for areas smaller than states.) The population of minor civil divisions, including towns and cities, is not classified by sex, and thus the opportunity to analyze the effects of the migration of young men from old to new communities and check up some of the surprising figures in the government census of 1910 was lost.

It appears from the table showing the population of the state at different censuses (after correcting a few typographical errors) that the average quinquennial increase from 1880 to 1885, 1890 to 1895, etc., has been a little greater than that from 1885 to 1890, etc., which may indicate that the state censuses are the more complete, although the last one was taken in midsummer, when thousands of Floridians were away from home, while the last government census was taken in spring. The population on July 1, 1915, excluding inmates of the State Insane Asylum, was 921,618, an increase of 22.5 per cent in five years or 49.9 per cent in ten years, which is doubtless a more rapid increase than in any other eastern state during the same periods. The percentage of whites, 60.7, is higher than that in each of the five states from South Carolina to Louisiana inclusive.

This last report, unlike the preceding one, contains no map, but the lack is partly supplied by a fine large state map, 1:633,600, distributed gratuitously by the agricultural department about the same time. This map (which is revised every few years) does not show any subdivisions of counties, however, other than townships and sections, so that the statistics of population for minor civil divisions in the census report are of little value for geographical purposes. ROLAND M. HARPER.

Committee to Expedite the Completion of the Topographic Map of the United States. At the third joint meeting of the Association of American Geographers and the American Geographical Society in New York on April 14 and 15, Professor W. M. Davis spoke informally on the desirability of accelerating the production of the topographic map of the United States (see the May *Review*, Vol. 1, p. 367). Since then a committee, organized by its chairman to promote this object, has sent out a circular letter to some two thousand addresses in all parts of the country. The committee consists of the following members: W. M. Davis, chairman, emeritus professor of geology, Harvard University, Cambridge, Mass.; A. E. Burton, secretary, dean, Massachusetts Institute of Technology, Cambridge, Mass.; Robert Bacon, president, National Security League, New York; Arthur H. Blanchard, consulting engineer, National Highways Association, professor of highway engineering, Columbia University, New York; G. P. Coleman, State Commissioner of Highways, Richmond, Va.; G. E. Condra, president, National Conservation Congress, State University, Lincoln, Nebr.; W. L. Darling, chief engineer, Northern Pacific Railway Co., St. Paul, Minn.; R. E. Dodge, president, National Council of Geography Teachers, Washington, Conn.; A. B. Fletcher, State Highway Engineer, Sacramento, Cal.; W. Cameron Forbes, of J. M. Forbes and Co., Boston, Mass.; John R. Freeman, consulting engineer, Providence, R. I.; W. O. Hotchkiss, State Geologist, Madison, Wis.; F. H. Newell, professor of civil engineering, University of Illinois, Urbana, Ill.; Joseph H. Pratt, State Geologist, Chapel Hill, N. C.; Wm. Barclay Parsons, consulting engineer, New York; Charles A. Stone, of Stone and Webster, Boston, Mass., president International Corporation, New York; Frank M. Williams, State Engineer, Albany, N. Y. The committee recognizes the excellent work of the U. S. Geological Survey, which has been carrying on the topographic survey of the United States for the last 35 years, and its appeal implies no criticism of this able organization. The outstanding fact is, however, that at the present rate of progress, in spite of liberal appropriations from Congress and generous co-operation from a number of states (see table), it would take about one

COST AND RATE OF PROGRESS OF THE TOPOGRAPHIC MAPPING OF THE UNITED STATES

YEAR ENDING JULY 1	APPROPRIATIONS		AREA IN SQUARE MILES		PERCENTAGE OF U. S. COMPLETED
	BY CONGRESS	BY STATES	SURVEYED	RE-SURVEYED	
1906	$489,200	$102,600	36,608	4,195	33.0
1907	459,200	121,800	32,495	1,847	33.8
1908	409,200	103,850	25,658	6,979	34.7
1909	384,200	100,000	23,831	11,200	35.5
1910	434,200	185,879	32,806	3,731	36.6
1911	434,200	156,376	25,496	6,460	37.4
1912	434,200	177,853	28,417	5,274	38 3
1913	434,200	161,267	18,731	3,987	38 9
1914	434,200	179,048	19,150	4,290	39.6
1915	434,200	186,800	20,527	3,048	40.2

hundred years to complete the mapping of the country. The handicap to many phases of our national development that such a situation entails does not need to be impressed upon geographers; and it is hoped that the appreciation of the value of the topographic maps which already exists among army officers, engineers, foresters, educators, and others will spread to include all who can derive benefit from their use. Every one who is interested in furthering the aim of the committee is urged to write to the secretary, Professor A. E. Burton, and to specify as definitely as possible the practical advantage that would accrue to him from the more rapid progress of our national map.

SOUTH AMERICA

The Lumber Markets of South America. This topic is discussed by Roger E. Simmons, Special Agent of the Department of Commerce, in two recently published reports (*Bur. of Foreign and Domestic Comm., Special Agents Series Nos. 112 and 117*, Washington, 1916). Argentina, Uruguay, and Brazil, especially the two first-named countries, constitute a valuable market for the lumber of North America. Uruguay is practically forestless, and, although Argentina possesses valuable forestal resources in the northern provinces, it is unlikely that these can ever replace the imported product. Apart from the cost and waste entailed in lumbering operations in the Chaco forests, the lumber obtained is in general only fitted for special purposes. With the exception of the Spanish cedar no tree has the equivalent usefulness of the imported softwoods—yellow pine, spruce, and white pine. The most valuable native species is the *quebracho*,

known for its high percentage of tannin and exported for such in the form of logs and extract. Other woods, as logs and rough forest products, find their way to the markets of the La Plata region, where is concentrated industry and commerce in both domestic and foreign lumber. Prior to the war, increase in the latter trade had led to notable change in the manner of shipment, i. e. the substitution of steamers for sailing vessels, whereby the cargo could be doubled or trebled and time reduced by one-half or one-third. A survey of Argentine forestal resources would include the woodlands occurring along a 1,300-mile stretch in western Patagonia. These forests, characterized by various species of beech and occasional conifers and araucarias, appear as five- to ten-mile strips along the watercourses. At present, with the exception of the extreme south that finds an outlet in the Chilean port of Punta Arenas, lack of communications precludes any attempt at development.

The Brazilian lumber industry is dissimilar in many respects from that of the La Plata region. Importation is distributed over a much greater area along the 4,000 miles of coast, though Rio de Janeiro and Santos account for the major part of the import. As in the La Plata district the chief imported wood is the southern yellow pine, locally known as the "pinho de Riga" from its resemblance to the resinous Russian pine that it has long since replaced, but there is also a not inconsiderable market for Scotch fir and Norway spruce from the Baltic countries. Brazil, with vast wealth in native forests, suffers the same impediments to development that are encountered in the Chaco. An exception to this is found in the recent exploitation of the so-called Paraná pine (*Araucaria brasiliensis*), a substitute for the northern conifers. This branch of lumbering, that was rendered possible by the construction of the Paraná railroad, presents an aspect entirely different from that of the rest of the industry. The characteristics of the araucarian forest are more favorable for lumbering, the species occurs in large and pure stands, and exploitation has been largely conducted by North American lumbermen.

The distinguishing feature of the lumber trade of the Pacific coast countries is the supremacy of the North American product. Punta Arenas, indeed, is the only port where European lumber is in greater demand. According to the latest statistics (1914) North America furnished 99 per cent of the imported lumber of Chile and a percentage only slightly less for Peru, where 80 per cent of the lumber of commerce is "piño de Oregon," Douglas fir. For both Chile and Peru the proportion between imported and domestic lumber also appears astonishingly high. This is particularly surprising with respect to the temperate forests of southern Chile, whose economic possibilities have long attracted attention (see, for example, "Account of the useful trees and shrubs of Chile, drawn up for the Court of Spain in obedience to the Royal Edict of July 20th, 1789, and forwarded with samples of the woods, etc., 10th December, 1792," given as a translation in the appendix to "Journal of a Residence in Chile," by Maria Graham, London, 1824). A careful examination of the resources of these forests seems to show that their intrinsic value has been overestimated. Little merchantable timber save wood for fuel is now obtained north of the old Indian frontier of the Bio-Bio. Much of the more accessible forest has already been cut for lumber or cleared for farming. The center of exploitation has moved 175 miles south during the last ten years; it is now located about Valdivia, where the best of the Chilean lumber is to be found. The Chilean beech forest does not, however, supply the best lumber of commerce. The *roble*, or so-called Chilean oak, the cheapest and most abundant native wood, shows two detrimental features common to other Chilean species: its weight impedes handling, and the difficulty in seasoning is troublesome in the rainy latitudes of southern Chile. The principal Chilean softwood is the peculiar and distinctive Chilean pine (*Araucaria imbricata*), a relative of the Brazilian species, the Paraná pine. Growing on the higher slopes of the Cordillera, it still plays an important part in the economy of the Indians of southern Chile. They make annual excursions to gather the seeds of the cone much as the seeds of piñon are gathered by the natives of the arid American West. From the lumbering point of view its chief value probably lies in its properties as a pulp wood.

With regard to the lumber trade Ecuador occupies a unique position among South American countries. No regular importation of foreign timber is made. The reason appears to lie in the heavy protection of the home industry, an attempt to revive its ancient importance, for in bygone days Guayaquil was famous along the whole coast as a shipbuilding center and an exporter of lumber.

On the northern coasts the situation is again different. Like other tropical countries Colombia and Venezuela possess forests extraordinarily rich in species but ill-favored for lumbering purposes by reason of the mixed and scattered nature of the stands, whence only a small percentage of the timber is merchantable. Venezuela, importing about 45 per cent of the lumber consumed, is a good market for the Southern yellow pine. In Colombia the demand for foreign woods is much less, but the trade is interesting

because of certain peculiar features. Prior to the war a considerable part of the trade was conducted through an intermediate market in Porto Rico where Southern yellow pine from the Gulf ports was exchanged for mahogany and Spanish cedar from the Colombian forests.

Bolivia and the Tin Industry. The canning industry of the United States consumes as much tinplate as is used for this purpose by the rest of the world combined. Most of the tin originates in the Straits Settlements, where the very high export duties on ore have necessitated exportation in the metallic form. Part is transmitted directly, part comes through Europe, chiefly through the United Kingdom. Yet in the western hemisphere is the world's greatest reserve of tin ores—the great deposits of the Eastern Cordillera of Bolivia. In 1912 Bolivia's tin ore shipment amounted to 38,614 tons and formed 66.8 per cent of the total value of exports. Of this quantity the United States took eight tons! In 1915 the estimated importation from Bolivia was still under one hundred tons.

Though known and used from time immemorial, Bolivian tin has only figured in the world's markets during the last twenty years. Prior to the last decade of the nineteenth century, Bolivia's vast mineral resources had but one expression—silver. Depreciation in the value of this metal and increasing industrial demand for tin are revolutionizing Bolivian mining. Abandoned silver mines have been reopened for tin, great dumps around the old shafts worked over and new mines sunk, and the prospects are encouraging. Oruro, in the geographical center of the tin belt, highly developed during the "silver" days and possessing superior means of communication, is also the economic center. North, near La Paz, and south, at Chorolque, are other important fields. Of individual mines the Monte Blanco of Inquisivi are among the most famous. Here one of the lodes, six to nine feet wide, outcrops for a thousand feet on the mountain side at an elevation of over 16,000 feet. It carries ore of 12 per cent ley—1½ to 2 per cent is considered rich in Cornwall—with occasional pockets of pure cassiterite. Special interest attaches to this group of mines from the up-to-date methods and machinery employed, for it is one of the properties of that romantic figure of Bolivian mining—Don Simon Patiño, the "Tin King" (*Commerce and Finance*, No. 46, Nov. 17, 1915, New York; see also Paul Walle: Bolivia, 1914, Chapter 19).

The recentness of the development and the geographical inertia of the industry have been seconded by economic and industrial limitations. Unlike the Malaysian ore, the Bolivian product contains ferruginous impurity, unremovable by the usual processes of smelting and highly detrimental to its use for plating. But the shock and stimulus of the European war have made themselves felt in this as in other industries of the western hemisphere. Bolivia, too short of motive power to smelt her ores, has entered into agreement with certain American capitalists for the shipment of ores to this country. There they will be smelted by a new electrolytic process in the works at Perth Amboy, N. J., now being erected for the purpose. The establishment of such a current of trade should prove beneficial to a far-reaching degree as a foundation for the establishment of credit and the extension of general commerce between the countries concerned (Bolivian Tin in the United States, *Bull. Pan American Union*, Feb., 1916; *Board of Trade Journal*, Nos. 999 and 1004, 1916). We may look for a marked rise on the figures of 1912, when Bolivia's commerce with the United States comprehended 9 per cent of the imports and one-half of one per cent of the exports. (See also The World's Tin, *Commercial America*, Vol. 12, No. 9, Philadelphia, 1916.)

EUROPE

Geographical Instruction in Great Britain. The growth of geographical education in Great Britain has lately been outlined by Dr. Scott Keltie in the *Geographical Teacher* (Thirty Years' Progress in Geographical Education, No. 38, Vol. 7, Part 4, London, 1914) and the *Scottish Geographical Magazine* (A Half-Century of Geographical Progress, Vol. 31, 1915, No. 12). Under the auspices of the Royal Geographical Society, Doctor Keltie was himself a prime initiator of the new geographical movement that began a little over thirty years ago with an investigation into the position of geography in education. Following the investigation, the stimulus and financial support of the Royal Geographical Society obtained for geography a recognized place in the universities—first in Oxford, where a notable beginning was made under the guidance of Mackinder, a little later in Cambridge and London, and subsequently in other universities and colleges, until now geography has an academic standing in practically every center of higher education. Its university status may be found in detail in the *Geographical Teacher* (Geography in British Universities, No. 37, Vol. 7, Part 3, 1913): the several syllabuses show the breadth of the instruction. By degrees the new geography

permeated from the colleges to the secondary and primary schools. The Geographical Association, organized in 1893 and now numbering over a thousand members, has afforded material aid by its investigations and recommendations and by its publications, including, since 1901, the *Geographical Teacher*. By 1905 the Board of Education had been aroused to a need for geographical education in the secondary schools. The new regulations of that year required the devotion of a specified amount of time to regular work in geography. Now geography is provided for in a four years' course intended to cover a complete world survey. In primary education less has been accomplished because of the difficulty in securing properly trained teachers. The fault lies chiefly with the training colleges, where until very recently geography figured in the program—often merely nominally in combination with history. Since 1913 geography has been promoted to a position of general and definite instruction.

Geography has thus secured a place in scholastic curricula: the future work of the teacher lies in the interpretation of its broad and far-reaching aims. An important trend of this interpretation appears in two recent articles by Dr. H. J. Fleure of the University College of Wales, Aberystwyth. "Suggestions for Investigations in Human Geography in Britain" (*Geographical Teacher*, No. 37, Vol. 8, Part 3, 1913) outlines a scheme for local geographic study. Its striking interest lies in the morphological standpoint taken. The point of view is discussed in the second paper, "Regional Surveys in Relation to Geography" (*ibid.*, No. 42, Vol. 8, Part 2, 1915), originally delivered as an address at the Imperial Institute in connection with Professor Geddes' Provisional Committee for the Development of Regional Surveys. A plea is made for humanistic treatment, under which geography can be made "a potent spiritual influence, promoting refinement of thought and breadth of appreciation, and thus contributing most effectively to good citizenship."

Atmospheric Pollution in England and Scotland. The results of observations made with a standard type of dust and soot collecting gage in English and Scotch towns are interesting. The maximum fall of soot and dust was recorded in Oldham, where the amount was 31.2 metric tons per square kilometer per month. Manchester comes second, with 26.8 metric tons. The Oldham fall is equivalent to 957 tons (British†) per square mile per annum. The figure for Sheffield is 21.7 metric tons per square kilometer per month. Our own Pittsburg has 33.6. R. DEC. WARD.

Navigation in the White Sea. The conditions affecting navigation in the White Sea—a subject which the war has made of vital importance to Russia (see "Russia's War-Time Outlets to the Sea," in the February *Review*, Vol. 1, pp. 128-132)—are discussed by Monsieur Gilinsky in the February, 1916, number of the *Bulletin of the Imperial Russian Technical Society*, whose article is summarized by J. Vichniak in the June 15 issue of the *Revue Générale des Sciences* (p. 330).

According to this article the White Sea is far from being inaccessible to all-year traffic. The summer freedom from ice continues until January (see also, below, note on "Ice Conditions in the Arctic Seas in 1915.") About this time, ice begins to form along the mouth of the rivers flowing into the sea and gradually extends outwards toward deep water. But this ice rarely exceeds an average of 20 inches in thickness and it is generally porous and brittle. Winds and currents combine to maintain it in a crushed condition. The ice banks of the open sea also make their appearance at the beginning of the year but they are seldom continuous, and navigation is possible during the months of February and March, when freezing attains its maximum.

The real dangers to navigation begin when the melting period sets in. Even then, however, the use of ice-breakers makes the White Sea harbors accessible to commerce. In spring, as a rule, the brittleness of the ice becomes marked in the upper layers, while the submerged portions acquire greater strength on account of the lower temperature then prevailing in the lower sections of the water. By May, however, the White Sea is free of ice. This often happens earlier, especially whenever winds from the west or southwest have prevailed in April.

According to recent *Commerce Reports* (July 24, 1916) a great rush of steamers to White Sea ports occurred this season. The ports of Soroka and Kem, both of which are now connected by broad-gage tracks with Petrograd, are fast becoming busy centers of shipping. Archangel, however, leads, owing to better connections with inland districts. It is estimated that over 2,700,000 tons of cargo will be transported inland from this port during the present season.

A Projected Southern Transcontinental Railroad in Europe. Attention is called to the projected Simplon-Belgrade railroad route in an article on "The Adriatic Slavs and the Overland Route to Consantinople" by Sir Arthur Evans in the April, 1916,

number of the *Geographical Journal*. The line will pass through non-Teutonic territory, Switzerland, Italy, and the Slavic districts of Austria being traversed until Belgrade is reached. East of the Istrian peninsula two routes, passing respectively by Laibach or Fiume, are available. Railroads are now in operation along the greater part of the stretch, and the linking of the necessary connections can be undertaken without difficulty.

The establishment of this line would revive the ancient route between the East and West which followed the Save valley. It is estimated that thirty-nine hours will suffice to bring the tourist from London to Belgrade—a saving of five hours over the time taken by the Orient Express before the war. Another advantage which might appeal to travelers is that this line attains the sea midway, at Venice and Fiume.

Now that continental connection with the Greek system of railways has been established (see the September *Review*, p. 227), the construction of this new transcontinental line would link the port of Piræus with a rapid route to England. From the Greek harbor to Port Said the time of travel is approximately twenty hours less than from Brindisi. A future rapid route to the East might be created by these connections and serious competition to the line following the Danube valley created.

The Quaternary Snowline in the Iberian Peninsula. In connection with glacial field work during the summers of 1914 and 1915, Hugo Obermaier and Juan Carandell made observations on the past and present snowline of the mountain ranges of Spain and Portugal, the results of which they have recently published (Datos para la Climatologia Cuaternaria en España, *Bol. Real Soc. Españ. de Hist. Nat.*, Vol. 15, 1915, pp. 402-410, Madrid). Two suggestive profiles through the Iberian Peninsula are presented, one from east to west approximately along the 41st parallel, and the other from north to south along the 5th meridian west of Greenwich, the latter extended so as to include the Atlas ranges of Morocco. The profiles show that the Quaternary limit of perpetual snow increased progressively in elevation from north to south in the peninsula, and from east to west, the former in keeping with the latitudinal effect on climate, the latter due to the change from the marine climate of the west coast to the dry land-climate of the interior.

The profiles are summarized in the following two tables.

E-W Profile			N-S Profile		
RANGE	MAXIMUM ELEVATION	ELEVATION OF QUATERNARY SNOWLINE	RANGE	MAXIMUM ELEVATION	ELEVATION OF QUATERNARY SNOWLINE
Serra da Estrella	1991 m	1400-1500 m	Picos de Europa	2672 m	1400-1500 m
Sierra de Béjar	2401 m	1800 m	Sierra de Guadarrama	2406 m	2000-2050 m
Sierra de Gredos	2592 m	1800-1900 m	Sierra de Gredos	2592 m	1800-1900 m
Sierra de Guadarrama	2406 m	2000-2050 m	Sierra Nevada	3481 m	2400-2500 m, N slope 2600-2700 m, S slope
Montes Universales	1610 m	mountains too low to be within reach	Er Rif	2200 m	mountains too low
Sierra de Javalambre	2020 m		Middle Atlas	4000 m	3280 m, N slope 3480 m, S slope
Peña Golosa	1813 m		High Atlas—		
			Ari Ayash	4250 m	3700 m, N slope 3900 m, S slope
			Tizi-n-Tamdjurt	4600 m	4400 m, N slope 4500 m, S slope

In the second table, the interruption of the progressive rise due to the lower elevation of the Sierra de Gredos snowline is a local variation due to the fact that this range is higher than the Sierra de Guadarrama, which is in the same latitude, and consequently carries a larger and more persistent snow cover.

The values with regard to the Atlas ranges are hypothetical. They have been obtained by prolonging southward the ascending line which passes through the snowline of the Iberian ranges. In addition, allowance has been made for the greater elevation of the snowline on the southern as compared with the northern slopes and for the effects of increased dryness on approach to the desert. The known difference for the Sierra Nevada, 200 meters, has been applied to these ranges, with the result given in the table. These figures, pending field work, afford a working approximation, which, incidentally, is in the nature of a compromise between the view which assumes that the Atlas ranges bore no glaciers in Quaternary time and the opposite assumption that they were glaciated down to a level of 1,800 meters.

ASIA

Strategic Geography of the Gallipoli Campaign. The southern shores of the Dardanelles and the entire Troad region form the subject of an illuminating article contributed by Dr. Walter Leaf to the June number of the *Geographical Journal* (pp. 401-421). Having had the advantage of personal experience on the site which he describes, Doctor Leaf is able to show all the more clearly how intimately the problem of forcing the straits depended on their physical features.

A fact rendered obvious by experience, and one which the geographer might have pointed out long before any action was undertaken, is that no naval effort could meet with success against the obstacles placed by nature in this region. The passage of a narrow tortuous waterway, 30 miles long, guarded by a complicated system of abrupt heights, as well as by a strong current down which mines float readily, was an impossibility. Among the difficulties which lay in the way of the Franco-British expeditionary force were a system of Tertiary cliffs running between Lampsacus and the entrance of the straits. This formation consists of clayey and sandy marls. While not exactly precipitous, they are steep enough to prevent landing except in occasionally intervening short stretches of coastal plain. These clays and marls become a real obstacle in the western approaches to the Troad, where they guard the southern coast from the mouth of the Dardanelles. Besika Bay, on this coast, is available as a landing station, but its value as the base of an expeditionary force is annulled by a line of marches which render advance towards the plain of Troy extremely hazardous. The only practical approach to the plain of Troy, according to Doctor Leaf, is found on the north coast of the Troad near the entrance of the Dardanelles. The military history of the region is instructive on this point, and enlightening references to the procedure adopted by ancient armies abound in the article.

A New Siberian City. Progress in the settlement of Siberia is the theme of two articles (''Rapid Growth of Siberia'' and ''Siberian Village Life'') in the Russian Section of the *London Times* for August 26, 1916. The particular case reviewed is the extraordinary growth of Novo-Nikolayevsk on the Ob River where it is crossed by the Trans-Siberian railroad. The recent completion of the Altai railroad, which runs from Novo-Nikolayevsk to Barnaul, with a branch to Biisk on the upper Ob, and to Semipalatinsk, thus tapping rich agricultural and mining districts, has further stimulated the city's growth. The writer, who visited the spot in 1898, then found that ''a small railway car, dismantled and propped up alongside the track, did duty for a railway and telegraph station,'' while ''about one mile away on the river's bank a tiny collection of unpainted log huts'' represented the sole population of the district. Now on this site is a town of 100,000 people, and, unlike most of the older Siberian cities, it is essentially modern. It has well-paved streets, electric lighting, and many fine stone buildings. Land purchasable in 1898 for 1 rouble per desiatin (2.7 acres) now sells at half as much per square foot. Novo-Nikolayevsk owes its growth to its position as a ''window to Europe'' for the vast Altai region. Its citizens hopefully anticipate further progress with construction of the projected railway line from the lower Ob to the White Sea or direct to the Arctic, when the town will naturally become a transshipping center for the upper river.

Foreign Commerce in the Philippines. With a total value of a little under $61,500,000, representing an approximate gain of 25 per cent on the average of the last five years, the Philippine export trade of last year constitutes a record (advance report on Philippine Foreign Commerce in the Year Ending June 30, 1916, Bureau of Insular Affairs, Washington, D. C.). Excepting copra, which was still suffering from the effects of the droughts and typhoons of the preceding season, all important export products showed an increase both in amount and value. This was notably the case with hemp and the allied fiber, maguey, and sugar. The increase in sugar is especially remarkable, the export for the first time exceeding the maximum of 1893. The sugar industry, decadent during the early days of American control, began to recover in 1909 under free trade with the United States and has lately been helped by war conditions. To the stimulus of the latter may be accounted the increased shipments to the Orient and the entirely new trade with the United Kingdom. The import trade, though improved over that of the previous year, remained below normal. The only important gains were made with the United States, Japan, and French Indo-China. The last named is attributable to heavy imports of rice to meet the shortage following the drought of 1914, and the increased Japanese business is partly due to the coal trade taken over by that country from Australia.

POLAR REGIONS

Ice Conditions in the Arctic Seas in 1915. Ice conditions in the Arctic were not uniform in 1915, according to a report by C. I. H. Speerschneider entitled "The State of the Ice in the Arctic Seas, 1915," recently issued by the Danish Meteorological Institute in its *Nautisk Meteorologisk Aarbog* for 1915.

Around Spitzbergen navigation was somewhat more arduous than in previous years. Spring opened with the promise of a severe icy season. In June the ice along the west coast covered an area larger than that of the island. According to sealers' reports the floes were packed so closely that they prevented approach to the fiords. The coast was blocked farther north than Prince Charles Foreland. These conditions are rarely witnessed; since the inauguration of the institute's investigations in 1897, it has been a rare occurrence for the ice to extend west of 10° E. A slight amelioration was observable in July, although all the west coast was ice-bound in August. Relatively favorable conditions existed on the north coast, but sailing north around North East Land or through Hinlopen Strait was impossible.

An improvement in White Sea conditions was attained in 1915 by the steady use of ice-breakers. Navigation was thus open till the end of the year. The ice in Barents Sea was normal except around Bear Island. An unusual southerly extension of ice is recorded for the period between April and June. Not until the end of this last month was the water around the island open.

In Iceland, polar ice east of Cape North hindered steam navigation in and out of the northwest fiords in the early spring of 1915. The ice then spread northward to such an extent that in June traffic round Cape North and adjacent stations was blocked. It was only in the last days of July that the sea was open on the north coast of Iceland. This favorable condition prevailed for the rest of the year.

The eastern coast of Greenland was normal. Ships had easy access to Angmagsalik station from the autumn of 1914 to August, 1915. On the northern part of the west coast the land floes of April and May gave way to open ice from June onward, and the release of icebergs became marked in July. In Smith Sound a severe winter was experienced, but the ice commenced breaking earlier than usual in May.

The Newfoundland Banks had less ice than in 1914. The southernmost iceberg was seen on May 5th in 39° 53′ N. and 47° 24′ W. Very few icebergs reached 40° N., however.

North of Alaska, conditions in the Beaufort Sea were normal. In spring the sea was frozen over near Banks Land. The passage through Bering Strait was free of ice during fall.

Probable Loss of Two Russian Arctic Expeditions. The probable fate of the Rusanoff and Brussiloff expeditions has already been referred to (*Bull. Amer. Geogr. Soc.*, Vol. 47, 1915, pp. 53-54, 288, and 961). Both were sent out under the auspices of the Archangel Society for the Study of the Russian North. The former left Spitzbergen in the motor boat *Hercules* in August, 1912, for Nova Zembla; the latter left a month later. After two years had elapsed without news from either, the Russian government sent out the Norwegian vessel *Eclipse* under Captain Sverdrup in July, 1914, to rescue the missing expeditions. The *Eclipse* returned to Archangel in September, 1915, without any news of the missing expeditions. Since then another year has passed without news, and the Russian government has therefore just announced through the medium of the Canadian government (press despatch from Ottawa dated September 8) that it officially considers both expeditions lost.

WORLD AS A WHOLE AND LARGER PARTS

The Japanese Abroad. A critical interpretation of Japanese emigration statistics, presented by R. Biasutti in the April-May, 1916, number of the *Rivista Geografica Italiana*, reviews the conditions under which the movement is taking place. The same topic was discussed in detail in an article entitled "Die Japanische Auswanderung" by Dr. Ernst Schultze in *Petermanns Mitteilungen* for April, May, July, and August, 1915 (see comment on map in *Bull. Amer. Geogr. Soc.*, Vol. 47, 1915, p. 727). Basing himself on figures for the year 1911, Biasutti assumes that about 800,000 Japanese are now scattered outside their native land. Of these one-half have invaded Sakhalin, Korea, and Formosa. In Asiatic countries the inflow of Japanese residents has become distinctly a phase of economic penetration. China alone contains over 130,000 Japanese immigrants, of whom a good half consists of women. Inasmuch as the ratio of male to female colonists is the criterion of permanent or temporary settlement, it follows that the Japanese generally go to China with the intention of taking up a permanent abode. On the eastern coast of the Pacific, however, the proportion of women among the immi-

grants is relatively low, the highest percentage being 23.7 for Mexico, while for Peru it is as low as 3.8. This figure becomes 12 per cent in the United States and increases to 17 per cent in Canada. In the Hawaiian Islands it attains 36.5 per cent.

The importance of the Japanese penetration in China can be realized from the fact that 60 per cent of the total number of emigrants in Kuantung and the Manchurian sphere of Japanese influence belong to the leading and industrial or commercial classes. The first-named of these localities contains between 45,000 to 50,000 Japanese inhabitants, while the second follows closely with about 40,000. Within the Russian sphere of influence in Manchuria the number of Japanese dwindles rapidly and rarely exceeds 2,000.

Anglo-Saxon America as a field of colonization for the Japanese is closed. Not so, however, with Latin-America, which the Asiatic islander is free to enter, but where he rarely elects to become permanently domiciled. Brazil alone, among the Latin-American states, has attracted the Japanese farmer. In the countries of Spanish speech he usually appears as a trader or a laborer. An agriculturist in Brazil, he also becomes a settler, the fact being revealed in the percentage of Japanese women in this republic —a figure which in 1911 was as high as 41. Most of this Japanese colonization in Brazil is confined to the state of São Paulo and is due to the possibility of rice cultivation.

Uniform Pan-American Monetary Unit. A recent issue of the *South American Journal* (Vol. 80, No. 24, London, 1916) discusses the Pan-American monetary unit proposed at the conference lately held in Buenos Aires. The proposal was to create a standard coin, equivalent in value to one-fifth of the United States dollar, for general circulation in the countries of the Pan-American Union. Apart from theoretical considerations as to the desirability of such a measure there are pronounced practical difficulties dependent chiefly on the debased condition of the monetary currency in many of the Latin-American republics. The great development of Argentina's resources has indeed placed that country on an unusually favorable footing among her sister republics, but it is exceptional. Most of the smaller countries, especially some of Central America, are still in states of indebtedness and monetary trouble from which they can only emerge by an economic progress that must inevitably be of slow growth.

PHYSICAL GEOGRAPHY

Fluctuations of Solar Radiation. The importance of fluctuations of solar radiation —regular or irregular, in long periods or in short periods—in relation to "changes" of climate, gives a distinct geographic interest to such work as that carried on by the Astro-Physical Observatory of the Smithsonian Institution. In his Annual Report for the year ending June 30, 1915, Dr. C. G. Abbot, the Director, points out that short-period fluctuations of solar radiation were large in 1913, but small in 1914. In association with these rapid, irregular fluctuations there are variations of contrast of brightness between the center and edges of the sun's disk. Greater contrast is associated with greater solar radiation and with numerous sunspots in the general march of the sun's activity; lesser contrast is associated with greater solar radiation in the march of the quick, irregular fluctuations of the sun's emission. Two causes of solar variation seem to be indicated by this paradox. The long period changes may be caused by changes of the sun's effective temperature attending the march of solar activity. The quick fluctuations may be ascribed to changes in the transparency of the outer solar envelopes.

R. DEC. WARD.

GEOGRAPHICAL NEWS

Weather Charts of the North Atlantic Ocean. Beginning with the issue for August, 1915, the successive numbers of the *Monthly Weather Review* have contained charts showing the weather conditions over the North Atlantic Ocean, for the same month, but one year previously. These charts give the averages of pressure, temperature, and prevailing wind directions at Greenwich mean noon, together with the location and courses of the more severe storms of the month. The discussion summarizes the more important meteorological conditions, with special reference to the storms which crossed the North Atlantic.

R. DEC. WARD.

PERSONAL

MR. O. P. AUSTIN, assistant chief of the Bureau of Foreign and Domestic Commerce, will give a lecture on South America on November 7 at Public School 132, Manhattan.

MR. F. W. COWIE, chief engineer of the Harbour Commissioners of Montreal, read a

paper on "Canadian Ports" at the Fifth Annual Convention of the American Association of Port Authorities held in Montreal on September 13, 14, and 15.

DR. P. H. GALLÉ of the Dutch Meteorological Office read a paper on January 29 before the Academy of Sciences of Amsterdam entitled "On the Relation Between the Summer Changes of the North Atlantic Trade Winds and Winter Temperature in Europe."

MISS CAROLINE W. HOTCHKISS of the Horace Mann School, New York, will give a course of five lectures on "Great Cities" at the 96th Street Branch of the New York Public Library, Manhattan. The dates and subjects of the lectures are as follows: October 2, Gary, the City Made to Order; October 9, New Orleans and Its Debt to the Mississippi; October 16, Denver the Gift of the Plains and the Mountains; October 23, San Francisco by the Golden Gate; October 30, Portland and the Columbia River. The subject of these lectures is substantially that dealt with in Miss Hotchkiss' book "Representative Cities of the United States" (reviewed in the *Bull. Amer. Geogr. Soc.*, Vol. 46, 1914, p. 776).

SIR JOHN KENNEDY, consulting engineer of the Harbour Commissioners of Montreal, read a paper entitled "St. Lawrence River and Canals of Canada" at the Fifth Annual Convention of the American Association of Port Authorities, held in Montreal on September 13, 14, and 15.

DR. WILLIS T. LEE of the U. S. Geological Survey gave an address on "The Birth of the Rockies" before the Colorado Academy of Sciences in Denver on September 26.

PROFESSOR EMMANUEL DE MARTONNE, professor of geography in the Sorbonne, arrived in New York on September 18 to take up his work as visiting French professor at Columbia University. He will give courses on European physiography under the auspices of the Department of Geology. His offerings will include two courses of four lectures each, delivered in French and open to the public. The subjects and dates of these lectures are: (1) Montagnes du Centre et Sud de la France, 4.15 P. M. (Massif Central) October 19 and 26, November 2, and (French Alps) November 9; (2) Plaines et Champs de Bataille du Nord de la France, 8.15 P. M., November 15, 22, and 29, and December 6. In connection with this series of lectures, there will be conferences, open to advanced students, in which a detailed study of certain phases of the work will be made. Professor De Martonne will also co-operate with Professor D. W. Johnson in a course on the physiography of Europe, in which the Alps, the Carpathians, and southeastern Europe will be discussed by Professor de Martonne.

PROF. E. S. MOORE of the Pennsylvania State College lectured before the Mining and Geological Society of Lehigh University on April 13 and before the students of the department of geology at Cornell University on April 26 on "Some of the Mining Fields of Australia and India."

DR. FRANCIS ROLT-WHEELER will give a course of six lectures at Public School 61, Manhattan, dealing with the activities of various government bureaus. The dates and subjects of his lectures are as follows: October 6, U. S. Geological Survey; October 20, U. S. Forest Service; November 3, U. S. Reclamation Service; November 17, U. S. Bureau of Fisheries; December 1, U. S. Bureau of Indian Affairs; December 15, U. S. Immigration Office.

MR. A. D. SWAN, consulting engineer of Montreal, read a paper on "Some Ports on the West Coast of South America, and Their Future Development" at the Fifth Annual Convention of the American Association of Port Authorities held in Montreal on September 13, 14, and 15.

DR. J. J. H. TEALL, F.R.S., late director of the Geological Survey of Great Britain, received the honor of knighthood on the occasion of King George's birthday.

GEOGRAPHICAL PUBLICATIONS

(Reviews and Titles of Books, Papers, and Maps)

For key to classification see "Explanatory Note" in the July number, pp. 77-81

NORTH AMERICA

UNITED STATES

South Atlantic States

—— ***Eagle Rock, Virginia, sheet.*** [***Topographic map of the United States.***] 1:62,500. Surveyed in 1908 and 1913; edition of 1915. U. S. Geological Survey, Washington, D. C. [An excellent illustration of the topography characteristic of three-cycle folded mountains. Parallel ridges of moderately even crest preserve a suggestion of the so-called Cretaceous peneplane of the Appalachian Mountain province, while the Tertiary peneplane is well preserved in the lowlands, except where the beautiful entrenched

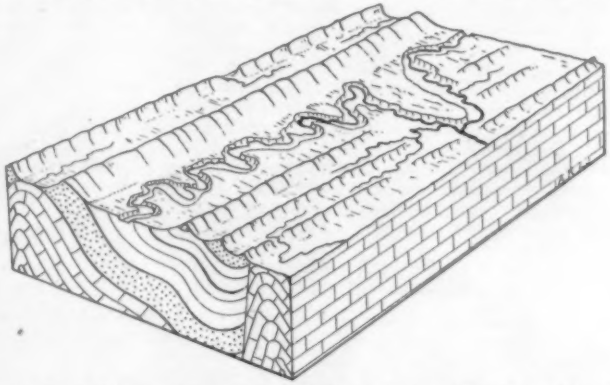

FIG. 1—Block diagram of the region about the headwaters of the James River, Virginia, from the Eagle Rock, Va., topographic sheet. Drawn by A. K. Lobeck.

meanders of the James River and its branches have opened out a post-Tertiary trench from one-fourth to one-half mile broad. Trellis drainage, water gaps, an occasional wind gap, and abandoned meander courses are well represented. The accompanying diagram is based on the northwestern two-thirds of the Eagle Rock sheet and shows the essential features of the region mapped.—D. W. J.]

North-Central States

SCHOCKEL, B. H. **Settlement and development of Jo Daviess County.** Maps, diagrs., ills., bibliogr. *Illinois Geol. Survey Bull. No. 26,* pp. 173-228 (Chapter 10). Urbana, 1916.

The dominant influences in the earlier settlement of Jo Daviess County (in the extreme northwestern corner of Illinois) were its mineral wealth and its location on the east bank of the Mississippi. Desultory Indian mining began to acquire significance with the advent of the white man. Early in the eighteenth century lead became a regular article of commerce between the Indians and the French traders. Galena, favorably situated on a navigable stream close to its confluence with the Mississippi, grew to prominence as a trading post. No very serious exploitation was undertaken until 1823: then the boom commenced and the usual influx of population followed.

It was estimated that the entire mining region of the Upper Mississippi contained not less than 10,000 miners in 1830, a cosmopolitan crowd including many Irish and men from the declining mines of Cornwall. The output grew enormously. The region contributed the major part of the supply that, in 1845, put the United States into the

foremost position as a world-producer of lead, whereas only fifteen years before she had been importing from Europe. As late as 1852 and even after rapid decline in output the region still accounted for 87 per cent of the country's total. Decay ensued with exhaustion of the richer and more accessible ores and was accelerated by the rival attractions offered by Californian gold and Lake Superior copper and also by internal changes favoring the development of agriculture and the progress of improvement works in the state. The fortunes of mining and farming were always more or less complementary. Farming was originally tributary to the mineral industry. It prospered most during periods of depression in the mines, but its progress was steady. By 1840 the number of farmers in the county exceeded the miners, and a few years later the regular export of agricultural produce was begun. Real agricultural expansion took place with the opening up of eastern routes. The county secured a portion of the migration from the North Atlantic states, although, located in the driftless area and possessing rough topography and poor soil it did not, as an agricultural district, compare favorably with adjacent lands.

The county naturally faces south. Its early intercourse was almost exclusively via the Mississippi; its early organizations and institutions had a Southern aspect. Exceptionally, a commercial outlet was found to the St. Lawrence, as in the days of the first French-Canadian traders, during the first readjustments following the Louisiana Cession, and still later for the supply of bullets to the English during the War of 1812. Eastward the vast extent of unsettled prairie barred the way until the construction of the Erie Canal and the establishment of steam navigation on the Great Lakes shortened tremendously the time and cost of transportation. The Illinois and Michigan Canal (1848) also accomplished something towards the eastward diversion of trade that was finally sealed by the construction of the railroad between Chicago and Galena in 1855. Not long after, in the Civil War, the eastern routes acquired a strategic importance as lines of communication transmitting food products and lead to the forces of the North.

Since 1870 the county has declined in population and general productivity. The decline has been greatest in the lead-producing townships. Data on property, land values, and so forth "seem to imply in some ways the economic inferiority of the mining to the non-mining townships." Further study of the problem here presented would be interesting.

There is a full list of bibliographic references, but many parts of the text have too much merely encyclopedic information unrelated to either real history or geography.

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CONDIT, D. D. **Structure of the Berea oil sand in the Woodsfield quadrangle, Belmont, Monroe, Noble, and Guernsey Counties, Ohio.** Maps, diagrs., bibliogr. *U. S. Geol. Surv. Bull. 621-O*, pp. 233-249. Washington, 1916.

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SHERMAN, L. K. **Illinois River flood.** Diagr. *Engineering News*, Vol. 75, 1916, No. 12, pp. 550-551.

SMITH, R. A. **The Saginaw oil field.** *Fifteenth Rept. Michigan Acad. of Sci.*, pp. 33-38. Lansing, 1913.

STREIGHTOFF, F. D., AND F. H. STREIGHTOFF. **Indiana: A social and economic survey.** With a chapter on charities and corrections by C. C. North. 261 pp. 9½ x 6½. [First five chapter headings read: The Physical Basis; Trees; Agriculture; Manufactures; Transportation.]

THWAITES, R. G., edit. (1) **The fur-trade in Wisconsin, 1812-1825;** (2) **A Wisconsin fur-traders' journal, 1803-04,** by Michel Curot. Ills., index. *Collections of the State Hist. Soc. of Wisconsin*, Vol. 20, pp. 1-395 and 396-471, respectively. Madison, 1911. [The Wisconsin Historical Society has undertaken the publication of a selected body of documentary material for first-hand study of the Wisconsin fur trade. This, the second volume, embraces the critical transition period between the years 1812-1825. American governmental control of the Northwest posts (1796) wrought little change until the War of 1812. Under the strain of political as well as commercial rivalry the old régime broke down, resolving itself into a struggle between the Government fur trade factories, the private traders, and the great American and Canadian companies. The period terminated with the triumph of the last.]

UPHAM, WARREN. **Explorations and surveys of the Minnesota and Red Rivers.** *Proc. Mississippi Valley Hist. Assoc. for the Year 1913-14* (Vol. 7), pp. 82-92. Torch Press, Cedar Rapids, Ia., 1914.

WILL, G. F. **The Cheyenne Indians in North Dakota.** *Proc. Mississippi Valley Hist. Assoc. for the Year 1913-14*, Vol. 7, pp. 67-78. Torch Press, Cedar Rapids, Ia., 1914.

SOUTH AMERICA

GENERAL

MOSES, BERNARD. **The Spanish dependencies in South America: An introduction to the history of their civilisation.** Vol. I, xxvi and 394 pp.; Vol. II, ix and 44 pp., index. Harper & Brothers, New York, 1914. 9 x 6.

As one of the few works of its kind written in English and as the mature result of long scholarly labor in the field to which it pertains, this book is welcome. In it is presented an account of what Professor Moses terms the middle period (1550-1730) of Spanish rule in South America—that "marked by the organization and development of political societies dependent on Spain." More than half the first volume, however, is concerned with the first period, that of the discoveries and great explorations. These introductory chapters are largely composed of material, selected and rearranged, from the author's earlier work, "Establishment of Spanish Rule in America," published in 1898.

The method is tropical in treatment, but as there is no conscious recognition of the fundamental importance of geographic relations the geographer must hunt through many weary pages to find material—and there is such—that will prove of interest to him. Under such circumstances one particularly deplores the lack of an organized and annotated bibliography that would allow further pursuit of the outcropping points of interest. To give one illustration: In the chapter on Travel and Transportation there is allusion to and quotation from "a letter dated August 3, 1729 (of) Padre Gervasoni" (Vol. 2, p. 388), but no clue as to where this seemingly interesting document may be found. The footnotes carry references to important and in some cases little-known source material, but they are disposed in so desultory and erratic a fashion that their use must be laborious or fortuitous.

ALBES, EDWARD. **Yerba mate, the tea of South America.** Ills. *Bull. Pan American Union*, Vol. 42, 1916, No. 5, pp. 625-643.

CLOSE, C. F. **Gravity deflections in the Andes.** Diagr. *Geogr. Journ.*, Vol. 47, 1916, No. 6, pp. 464-467.

DAY, L. G. **South American Trails.** Ills. *Amer. Museum Journ.*, Vol. 16, 1916, No. 1, pp. 23-44.

—— **Latin American description and history, Books and magazine articles on, received in the Columbus Memorial Library of the Pan American Union: Supplement No. 2.** 136 pp. The Pan American Union, Washington, 1914. [The original list was printed in 1907 and Supplement No. 1 in 1909.]

REID, W. A. **Motor cars and highways in South America.** Ills. *Bull. Pan American Union*, Vol. 42, 1916, No. 5, pp. 644-665.

REID, W. A. **Navigation on South American rivers.** Ills. *Bull. Pan American Union*, Vol. 43, 1916, No. 1, pp. 13-32.

SIMMONS, R. E. **Lumber markets of the east coast of South America.** 121 pp.; ills. *Bur. of Foreign and Domestic Comm. Special Agents Ser. No. 112.* Dept. of Commerce, Washington, D. C., 1916. [Abstracted in this number, pp. 304-306.]

SIMMONS, R. E. **Lumber markets of the west and north coasts of South America.** 149 pp.; map, ills. *Bur. of Foreign and Domestic Comm. Special Agents Ser. No. 117.* Dept. of Commerce, Washington, D. C., 1916. [Abstracted in this number, pp. 304-306.]

SPINDEN, H. J. **The question of the zodiac in America.** Ills., bibliogr. *Amer. Anthropologist*, Vol. 18, 1916, No. 1, pp. 53-80. [Was the zodiac a conception among pre-Columbian Aztecs, Mayas, and Incas? Probably not.]

EUROPE

BRITISH ISLES

CRESSY, EDWARD. **An outline of industrial history, with special reference to problems of the present day.** xiv and 364 pp.; diagr., index, bibliogr. Macmillan & Co., Ltd., New York, 1915. $1.10. 7½ x 5.

The past, about which the historians write, is dead. They especially aim to make it so in order that they may maintain that much-sought impartiality which history is supposed to possess. Thus the school book of history drops the boy off a generation or two ago and modern society demands that he go out and vote intelligently on the questions of the day. The interval between his school history and his ballot box is covered by a maze of governmental reports, monographs, and current, dilute, biased, usually ephemeral publications. Mr. Cressy's book is an attempt to guide the young Briton through this critical period and help him to understand the present.

There are eighteen chapters divided into groups. Under "Scientific and Technical Progress," chapters on food and farming, textiles, fuel, and science in industry cover 128 pages; facilities for commercial development, 55 pages; the evolution of industrial management, 37 pages; industry and politics (franchise, factory legislation, education, etc.), 75 pages. Lastly comes a carefully selected list of 76 books, by which the elementary student may extend his knowledge in particular fields. The frontispiece, a chart showing British population for eight centuries, is most striking. The book has been carefully prepared and gives an excellent brief review of British industrial history.

J. RUSSELL SMITH.

ANGELBECK, A. **Staffordshire (The agricultural geography of England on a regional basis, III).** Maps. *Geogr. Teacher*, No. 43, Vol. 8, 1915, Part 3, pp. 154-163.

BONE, LUCY. **Experimental work with young children on the Ordnance Survey map of the district of Sutton, Surrey.** Maps. *Geogr. Teacher*, No. 43, Vol. 8, 1915, Part 3, pp. 188-192.

BRODIE, F. J. **The incidence of bright sunshine over the United Kingdom during the thirty years 1881-1910.** Maps, diagrs. *Quart. Journ. Royal Meteorol. Soc.*, No. 177, Vol. 42, 1916, pp. 23-38.

CLAIBORNE, H. C. **Swansea.** *Suppl. to Commerce Repts.*, Ann. Series, 1916, No. 19b, pp. 11-15. Bur. of Foreign and Domestic Commerce, Dept. of Commerce, Washington, D. C.

CLAXTON, W. J. **An industrial geography of Britain.** 143 pp.; maps, diagrs., ills. George G. Harrap & Co., London, 1915. 9d. 7½ x 5.

CLAXTON, W. J. **Our country's industrial history.** 253 pp.; maps, ills., index. George G. Harrap & Co., London, 1915. 1s. 6d. 7½ x 5.

—— **Coal-fields in England, The search for new.** Map, diagrs. *Nature*, No. 2431, Vol. 97, 1916, June 1, pp. 292-294. ["Abridged from a discourse delivered at the Royal Institution on Friday, March 17, by Dr. A. Strahan, F.R.S."]

COMISSOPOLOS, N. A. **On the seasonal variability of rainfall over the British Isles.** Map. *Quart. Journ. Royal Meteorol. Soc.*, No. 177, Vol. 42, 1916, pp. 13-20. [A method of treating rainfall statistics suggested by the paper "Isomeric Rainfall Maps of the British Isles" by H. R. Mill and Carle Salter (*Quart. Journ. Roy. Meteorol. Soc.*, Vol. 41, London, 1915). This alternative method was tried by the author in the course of experimenting on data for the British Isles before applying methods to the discussion of the rainfall of northeastern Africa.]

COX, A. H. **The geology of the district between Abereiddy and Abercastle (Pembrokeshire).** Maps, diagrs., ills. *Quart. Journ. of the Geol. Soc.*, No. 282, Vol. 71, 1916, pp. 273-342. London. [With colored geological map, 1:15,840.]

DUNLOP, ANDREW. **On a raised beach on the southern coast of Jersey.** Diagr. *Quart. Journ. of the Geol. Soc.*, No. 282, Vol. 71, 1916, pp. 150-154. London.

EARLY, W. W. **Leicester Agency.** *Suppl. to Commerce Repts.*, Ann. Series, 1916, No. 19a, pp. 33-35. Bur. of Foreign and Domestic Commerce, Dept. of Commerce, Washington, D. C.

ELLIOTT, M. S. **The historical geography of the Weald as exemplified round Tonbridge.** Maps. *Geogr. Teacher*, No. 43, Vol. 8, 1915, Part 3, pp. 173-179.

HALE, F. D. **Huddersfield.** *Suppl. to Commerce Repts.*, Ann. Series, 1916, No. 19a, pp. 21-25. Bur. of Foreign and Domestic Commerce, Dept. of Commerce, Washington, D. C.

H[INKS], A. R. **The scientific work of the Ordnance Survey.** *Geogr. Journ.*, Vol. 46, 1915, No. 6, pp. 460-464. [Based on recent publications of that organization.]

HITCH, C. M. **Nottingham.** *Suppl. to Commerce Repts.*, Ann. Series, 1916, No. 19a, pp. 25-33. Bur. of Foreign and Domestic Commerce, Dept. of Commerce, Washington, D. C.

ISAAC, V. K. **The mouth of the river Cuckmere.** Maps, ills. *Geogr. Teacher*, No. 43, Vol. 8, 1915, Part 3, pp. 192-194.

JONES, O. T., AND W. J. PUGH. **The geology of the district around Machynlleth and the Llyfnant Valley.** Map, diagrs. *Quart. Journ. of the Geol. Soc.*, No. 282, Vol. 71, 1916, pp. 343-385. London.

KINVIG, R. H. **The historical geography of the West Country woollen industry.** Map. *Geogr. Teacher*, No. 44, Vol. 8, 1916, Part 4, pp. 243-254; Part 5, pp. 290-306.

RHODES, J. E. W. **Notes on the former courses of the River Devon: A suggested evolution for part of the river system of Fife and Kinross.** Maps, diagrs. *Scottish Geogr. Mag.*, Vol. 32, 1916, No. 5, pp. 209-216.

SAVAGE, J. M. **Sheffield.** *Suppl. to Commerce Repts.*, Ann. Series, 1916, No. 19a, pp. 35-40. Bur. of Foreign and Domestic Commerce, Dept. of Commerce, Washington, D. C. [Includes the progress of industry, e. g. the steel trade of Sheffield, consequent on the war.]

TAYLOR, S. M. **Birmingham.** *Suppl. to Commerce Repts.*, Ann. Series, 1916, No. 19a, pp. 11-21. Bur. of Foreign and Domestic Commerce, Dept. of Commerce, Washington, D. C.

THOMPSON, W. H. **The daily food ration of Great Britain.** *Nature*, No. 2416, Vol. 96, 1916, Feb. 17, pp. 687-690. ["There can be no doubt, and the fact needs reiteration, that the arable land of the United Kingdom is not used to the best advantage in the matter of food production."]

VAN SANT, H. D. **Dunfermline.** *Suppl. to Commerce Repts.*, Ann. Series, 1916, No. 19b, pp. 8-11. Bur. of Foreign and Domestic Commerce, Dept. of Commerce, Washington, D. C.

AUSTRIA-HUNGARY

KREBS, NORBERT. **Länderkunde der österreichischen Alpen.** (Series: Bibliothek länderkundlicher Handbücher, herausgegeben von Dr. A. Penck). xv and 556 pp.; maps, diagrs., ills., bibliogr., index. J. Engelhorns Nachf., Stuttgart, 1913. M. 20. 9½ x 6½.

The publishers of Ratzel's monumental "Bibliothek geographischer Handbücher" are undertaking another equally ambitious task. The new project, "Bibliothek länderkundlicher Handbücher," is under the editorial direction of Professor Albrecht Penck. In addition to the volume under discussion, two others have been announced, one on Scandinavia and one on the East Indies. The authorship of the series is international.

The present work by Doctor Krebs on the Austrian Alps is a notable addition to the

literature of regional geography. It is a careful and intelligent piece of work, the fruit of scholarly research on a comprehensive plan. The two chief problems of the author have consisted in following out the geographic factors in a region of great complexity and in resolving the area into coherent subdivisions, convenient for individual treatment. The author has combined the voluminous literature on the eastern Alps with his own intimate knowledge of the region into an account which contains an extraordinary amount of good geographic material. The only serious criticism is that in places geological and especially morphological facts are stressed unnecessarily. The American geographer will be interested to note that the author fears his Continental colleagues will find too little rather than too much of this sort of thing and so deems it necessary to defend the amount of biogeographic material which is introduced.

Alpine conditions are pictured with remarkable clearness. This fact, combined with a diction at the same time vigorous and graceful, and for the most part also terse, make the book as a whole readable. Its utility for reference purposes is enhanced by the consistent and detailed use of section headings. Here and there an Austrian idiom raises difficulties for the reader.

The volume consists of two parts of contrasted treatment. The first part is a summary of the geography of the Austrian Alps as a whole. In the second part eight subregions are considered, largely by Davis' method of explanatory description. The first part may be read consecutively, the second part is intended primarily for reference purposes. Pages 8 to 14 are devoted to a suggestive discussion of the possible bases of geographic subdivision and to the scheme by which the sub-regions of the second part were determined.

A large part of the physiographic material in both parts consists of accounts of the manner in which rock formations have expressed themselves in topography and drainage. The nature and causes of soilflow, landslips, and related phenomena receive considerable attention. The topographic effects of climate and vegetation are properly brought out, and a graphic account is given of denudation on the southern slopes of the Alps, with their summer drought and limestone soils.

The great variations of climatic conditions from place to place are the result not merely of varying altitude but of varying disposition of mountain ranges and valleys. Where deep valleys open broadly to adjacent plains, the climate of the lowlands, with some modifications, may penetrate far into the mountains and cause certain passes, as the Brenner, to constitute striking climatic divides. The occurrence of the föhn and the inversion of temperatures in valleys are largely dependent on the position and configuration of the valley. A detailed precipitation map registers the partial exclusion because of mountain barriers of rainfall from certain valleys of western Tyrol. The intensity of insolation and high temperatures of the ground constitute the chief points of contrast between Alpine and polar climate and explain the early period of bloom of the Alpine flora and the rapid ripening of grain in the high valleys.

Chapters 8 to 10, dealing with settlement, economic conditions, and distribution of population constitute the most generally valuable part of the book. The student of European geography or of mountain environment will find here a remarkable wealth of material, which cannot be summarized adequately in a review. A single example therefore is given, the economy of the *alm*. The Alpine peasant distinguishes a number of alms, according to their position. The extension and subsequent contraction of the farm area with the seasons results in a somewhat nomadic domestic economy among the peasants of the alm, and feast-days of the inhabitants are connected with this migration. While the people are on the high alm-meadows they have the brief opportunity of associating with their neighbors from other valleys, and widely attended contests and celebrations result. The alm-meadows are managed most efficiently by common enterprise, so that ancient forms of communistic regulations are still largely observed. In some sections these grasslands have been unduly exploited with the result that stony surfaces appear and lower forms of vegetation are crowding in. Pasturing in forests and the depression of the upper limits of forests through wood-cutting also react unfavorably upon the alm-lands, which are largely at present in a period of depreciation.

The second part contains in disseminated form many notes on human geography. The difficulty of crossing the Arlberg has imparted to Vorarlberg a centrifugal tendency with reference to Austria. Innsbruck, in the east-west Inn Valley, at the northern base of the Brenner Pass, and controlling several routes to Bavaria, has had as the result of its location a long and important history, and is today secure in its supremacy among cities of the Tyrol. Geographic moments in the development of every city of note are established similarly, and the volume closes with an account of the geographic location of Vienna, of the changes in its plan, and of its economic significance.

Mention should be made of several successful cartographic experiments in the detailed representation of the distribution of cultures, of population, and the correspondence

between topography and forms of settlement. The half-tones are supplied with a brief physiographic and geographic explanation. CARL O. SAUER.

FINSTERWALDER, S. **Nachmessungen an Gletschern beiderseits des Brenner im Sommer 1915.** *Zeitschr. für Gletscherkunde*, Vol. 10, 1916, No. 1, pp. 51-56.

FRANCHI, ANNA. **Le città sorelle.** 214 pp. Fratelli Treves, Milan, 1915. 10 x 6. [The "sister cities" of the Italian-speaking borderlands of the Adriatic, including Trieste, Fiume, Pola, the Dalmatian coast towns, and the Italian cities of the "Trentino,"—Trent, Riva, Rovereto. Good illustrations.]

KOCH, NÁNDOR. **Die blaue Grotte von Busí.** Map, ills. *A Tenger*, Vol. 6, 1916, No. 2, pp. 76-81. Budapest. [In Hungarian.]

MAZELLE, EDUARD. **Über die Windverhältnisse in den höheren Luftschichten nach den Pilotballonbeobachtungen in Triest.** *Meteorol. Zeitschr.*, Vol. 33, 1916, No. 2, pp. 64-69.

AFRICA

SOUTH AFRICA

—— **Diamanten, Die deutschen, und ihre Gewinnung; Eine Erinnerungsschrift zur Landesausstellung Windhuk 1914,** herausgegeben von den Förderern. 95 pp., ills. Dietrich Reimer, Berlin, 1914. M. 3. 9½ x 6.

This interesting and elaborately illustrated work was issued in connection with the Windhuk exposition of 1914 and prepared under the direction of the Lüderitzbucht Chamber of Mines and the diamond-mining companies.

The existence of great diamond deposits in British South Africa naturally led to prospecting in German Southwest Africa, resulting in the discovery of some "blue ground" but no promising amount of diamonds. About 1908 reports were circulated of the discovery of diamonds near Lüderitzbucht, but they were received with scepticism, as all previous attempts to find any minerals of economic value in the desert area of that region had ended in failure. The discovery was due to a railroad engineer named Stauch, and, the diamond finds having been substantiated, a small stampede for the region took place.

The diamonds occur scattered through the dune sands, and all attempts to determine their exact source have thus far been unsuccessful. In 1913 the production amounted to about 1,500,000 karats, valued at 63,018,000 marks, while the total production to the end of that year was 4,693,321 karats, valued at 151,926,000 marks. A number of companies are engaged in working the diamond-bearing sands; the early operations were by hand, but the installation later of power-driven machinery has resulted in a considerably greater saving of gem stones. HEINRICH RIES.

LACY, GEORGE. **South African exploration: Pioneer hunters, traders, and explorers of South Africa.** Ills. ("South Africa" Handbooks reprinted from *South Africa*): No. 63, 32 pp., Oct., 1911; No. 81, 28 pp., Aug., 1915; No. 82, 28 pp., Dec., 1915; No. 83, 28 pp., May, 1916. Office of *South Africa*, London. 6d each. 6 x 5.

These four small books, containing in all a little over one hundred pages, briefly describe the work of some ninety pioneers who went to South Africa in the earlier days of white enterprise, to hunt, to prospect, or to travel. Most of them, having written no books nor otherwise attracted wide public notice, are unknown to fame. The task of finding them out and showing just what they did to shape the beginnings of our knowledge of South Africa was arduous; and much credit is due to the author for his laborious and successful efforts to bring them into the light. The leading men among them, such as C. J. Andersson, Captain J. E. Alexander, W. C. Baldwin, Thomas Baines, and a few others are known, however, through their writings.

The author's good work would have been more gracefully performed if he had omitted some wholly gratuitous disparagement of a number of leaders in African exploration. He says, for example, that Livingstone "always posed as the discoverer of Lake Ngami." What words can be found in all of Livingstone's writings to justify this remark? He traveled with the aid and in the company of the wealthy English sportsman W. C. Oswell; and it was fortunate for that gentleman that his protégé had the fitness to write the first account of the Kalihari Desert and of Lake Ngami as they found them. Livingstone made known the results of his studies; but it was Oswell's expedition and it was he who received the medal of the Paris Geographical Society for the discovery of the lake. CYRUS C. ADAMS.

—— **British South Africa Co., The: Directors' report and accounts for the year ended 31st March, 1915.** 40 pp.; index. London, [1916]. [Despite the war

Rhodesia has made satisfactory economic progress during the year ended March 31, 1915. This is shown by the agricultural and ranching returns as well as in the increased mineral production, still the dominant industry. Gold, maize, hides, and skins are the chief products contributing to the increased export. The Northern Territory owes not a little of its late advancement to the development of the copper mining in the Katanga district of the southern Congo.]

FRIEDLANDER, VERA. **The storehouse of the gold of Ophir.** Map, ills. *Travel*, Vol. 27, 1916, No. 2, pp. 14-17 and 48. [Account of Great Zimbabwe and the various archeological interpretations concerning it, including its possible identity with the Ophir of the Bible.]

LOUW, C. S. **A manual of the Chikaranga language, with grammar, exercises, useful conversational sentences, and vocabulary.** x and 397 pp. Philpott & Collins, Bulawayo, 1915. 12s 6d. 8 x 5½. [''Chikaranga is the language spoken by the natives of Mashonaland, Southern Rhodesia.'']

MELLOR, E. T. **The East Rand.** Map, diagrs. *Trans. Geol. Soc. of South Africa*, Vol. 18, 1915, Jan.-Dec., pp. 57-71.

—— **Moçambique, Caminho de ferro de, e recursos que oferece o norte desta provincia.** *Bol. Soc. de Geogr. de Lisboa*, Vol. 33, 1915, No. 9-10, pp. 327-332.

—— **Nyasaland: Report for 1914-15.** 21 pp. *Ann. Colonial Repts. No. 883.* London, 1916.

ROBERTS, NOEL. **The Baganano or Ma-Laboch: Notes on their early history, customs, and creed.** Ills. *South African Journ. of Sci.*, Vol. 12, 1916, No. 7, pp. 241-256. [''The Bagananoa are Bantus'' who ''occupy a strong position on the Blaauwberg Mountain, in the northern Transvaal, which they have held for about a century and a half.'']

ROGERS, A. W. **The geology of part of Namaqualand.** Map, diagrs., ills. *Trans. Geol. Soc. of South Africa*, Vol. 18, 1915, Jan.-Dec., pp. 72-101.

THORNTON, R. W. **The ostrich feather industry in South Africa.** *South African Journ. of Sci.*, Vol. 12, 1916, No. 7, pp. 272-279.

WAGNER, P. A. **The geology and mineral industry of South-west Africa.** xvi and 119 pp.; maps, diagrs., ills., index. *Union of South Africa Geol. Survey Memoir No. 7.* Pretoria, 1916. [Describes the country by physical divisions: see abstract in the August *Review*, pp. 155-156.]

ASIA

TURKEY IN ASIA, ARABIA, CAUCASIA, IRAN

SYKES, P. M. **A history of Persia.** Maps, ills., index, bibliogr. Vol. I, xxvi and 544 pp.; Vol. II, xvii and 565 pp. Macmillan and Co., Ltd., London, 1915. $15.00. 9 x 5½.

These volumes, based on a personal contact with Persia during a residence of twenty-one years and a mastery of the literature of ancient and modern Persia, are offered as a self-contained and complete history of the eastern country.

The author begins the work with three chapters on the configuration and climate of the land and follows this with as detailed an account as can be found of Persian history from the very hazy Neolithic period to the granting of a constitution in 1906. The introductory geographic description of Persia for a volume of this kind is remarkably well done. The author appears familiar alike with the early accounts of the country as issued by the Hakluyt Society or reported by its pioneer travelers and invaders and with the more recent discussions of de Morgan, Hedin, and Huntington. He is impressed, as others have been, with the apparent rapidity of the changes towards aridity which the condition of many of the provinces suggests. On the flora, fauna, and mineral wealth there are brief but illuminating paragraphs which, imbued with personal experiences, are more than catalogs. Before beginning the story of Persia's history the author introduces a chapter to show the changes in the land since the dawn of history and the result of these upon the inhabitants. The advances of the Mesopotamian Valley into the Persian Gulf, the former courses and volume of the rivers, especially the Euphrates, Tigris, Karun, and Oxus, and the mention by early writers of plants and animals now foreign to the land give a quantitative value to the description of Elam and Babylonia. In addition to all this, the book teems with illustrations of a wide variety of subjects, among them pictures of the land which give a good idea of the complexity and variety of Persia's scenery and the life conditions of its people. In these and the maps, which are particularly well executed, the volumes excel.

The main theme of the book is the historical account, and in this the geographer may find interesting and capable discussions of physical and social controls. Two chapters only are instanced: one on the struggle for the ascendancy of the Persian Gulf, which, as a strategic point in trade, has been under five European powers since Dias rounded the Cape of Good Hope in 1487; another on the art portraying the genius of Persia which is so strongly impressed in ceramics, textiles, and metal work.

Persia in recent years has been constantly before the public, and comprehensive and authoritative books dealing with the Persian point of view have not been within our reach. This void seems now to have been filled. It is strange, however, in dealing with a country which has been the seat of so much turmoil within a few years to publish in 1915 a book on the history of Persia which is no further down to date than the granting of a constitutional government by the shah Muzaffar-u-Din in 1906.

ROBERT M. BROWN.

CASANOWICZ, I. M. **A colored drawing of the Medeba mosaic map of Palestine in the United States National Museum.** Map. *Proc. U. S. Natl. Museum*, Vol. 49, 1916, pp. 359-376. Smithsonian Institution, Washington.

—— **Cyprus, Salt from.** *Bull. of the Imperial Inst.*, Vol. 14, 1916, No. 1, pp. 37-41. [Suggests the possibilities of expanding the ancient local salt trade of the island.]

HODGE, R. M. **Historical geography of Bible Lands: A manual for teachers.** xxi and 53 pp.; maps. Charles Scribner's Sons, New York, 1915. 11 x 8. [Teacher's manual, with references, for a course in "geography as a factor in Bible history."]

L[AUNAY], L. D[E]. **Les pétroles sur le front de l'Irak.** Map. *La Nature*, No. 2227, 1916, June 3, pp. 359-360.

ROOME, J. C. **Impressions of Persia and Mesopotamia.** *Asiatic Rev.*, No. 21, Vol. 7, 1916, Jan. 1, pp. 58-62.

SELWYN-BROWN, ARTHUR. **Ancient Mesopotamia and the irrigation system that made it a fertile territory.** Map. *Scientific American Suppl.*, No. 2106, Vol. 81, May 13, p. 309.

POLAR REGIONS

ARCTIC

PORSILD, M. P. **Studies on the material culture of the Eskimo in West Greenland.** Diagrs., ills., bibliogr. *Meddelelser om Grønland*, Vol. 51, No. 5 (=pp. 113-250). Copenhagen, 1915.

Apparently because the Eskimo's life is generally thought to be simple and primitive even the best of the current textbooks tell little more than the geographies of fifty years ago. Yet his life is not simple, and as an adaptation to environment it is still wholly untold save in memoirs like the one under review. Geographic writers should seize the wealth of available material and make it their own.

Between pages 131 and 140 is an extraordinary description of the vital intimacy between the Eskimo and his fiords and ice-fields. The exact hunting methods adopted depend upon the ice, whether old or new; the surface, whether snow-covered or glassy; the sun, whether low or high; the currents, icebergs, headlands, and the degree of cold. Certain types of boots fit one set of conditions and not another; and so it is with the rifle, bow and arrow, net, club, harpoon, kyak, and likewise the exact method of attack. In a storm, for example, the sleeping sea otter is easy prey because the new-fallen snow deadens the footsteps of the hunter. Higher grades of skill must be attained in hunting under difficult conditions, until at last the most expert may hunt in that inferno of risk and toil, the feeding grounds at the edge of the glacier ice at the fiord head where calving icebergs, open water, and tidal eddies take their steady toll of life.

A settlement has not merely a chance location nor is it made with respect to shelter alone. What is the habit of the ice, of the current, of the game? Where are the headlands? Will there be open water at the right season and near shore? What are the supplementary resources of the land? Is there driftwood? These are the persistent inquiries of a tribe in seeking a new location. There are no trees, hence the driftwood is from far distant sources. It follows that it is broken and small, and a single piece will rarely serve for a bow. Now a bow must have two qualities—rigidity and elasticity. To secure the one, pieces of wood, generally three, are bound tightly together; to secure the other, strips of walrus hide are fastened on either side. Porsild calls the result one of the greatest inventions of our (*sic*) time. They have nets of split whalebone and use them through and under the ice. A surplus of light and heat is their idea of luxury.

This is only attained when nature conspires against the game to man's benefit. Here is paradise:

"When severe cold sets in suddenly, and with calm weather, it frequently happens that a school of white whales, or narwhals, is cut off from the open water by a broad belt of ice. The whales soon become exhausted owing to the difficulty of breathing, and if they find an opening in the ice they all resort to it, and cannot leave it again. Here, from twenty to several hundred animals may be found at such an opening. If this opening is small the animals may lie closely together; the narwhals, for instance, pushing their way to the edge and placing their tusks upon the ice. In calm weather their moaning may be heard for miles around, and the steam from their breathing rises from the hole into the air, so that such a *savssat* [as such a place is called] is soon discovered. According to the hunting by-laws in force it is the joint property of the surrounding settlements, and the finder gets a reward at the public expense, and everybody may secure for himself the right of possession by thrusting a harpoon into an animal. As the animal cannot get away, the form of the harpoon is quite immaterial, and it is only necessary that a small piece of line be attached to it in order to identify it. One by one the animals are killed—formerly with lances, now usually with guns—, drawn up, and driven away on sledges, and this may be continued till the whole flock is captured, or till the weather turns and the ice is broken up, when the animals are set free."

There is also much on Eskimo migrations—a problem of growing interest; an admirable summary, pages 235-236; and a working bibliography that loses little in value because it includes only those books which the author had with him in Greenland.

ANDERSON, R. M. **Canadian Arctic Expedition, 1915.** *Summary Rept. Geol. Survey of Canada for 1915*, pp. 220-236. Ottawa, 1916. [See also items on "Return of the Southern Party of the Stefansson Expedition" and "Explorations in Victoria Island" in the September *Review*, pp. 232-233.]

[CHIPMAN, K. G., AND J. R. COX. **Report of the Topographical Division], Canadian Arctic Expedition.** *Summary Rept. Geol. Survey of Canada for 1915*, pp. 244 [original incorrectly 424]-245. Ottawa, 1916. [See also items in the September *Review*, pp. 232-233.]

—— **Expéditions polaires de Sverdrup et de Vilkickij, Radiotélegrammes des.** *Bull. de l'Acad. Imp. des Sci.* [*de Pétrograd*], Sér. 6, 1915, No. 7, pp. 566-584. [In Russian.]

GALITZINE, B. **Rapport sur la situation actuelle des expéditions polaires de Sverdrup et de Vilkickij.** *Bull. de l'Acad. Imp. des Sci.* [*de Pétrograd*], Sér. 6, 1915, No. 3, pp. 193-196. [In Russian.]

KOCH, J. P. **Vorläufiger Bericht über die wichtigsten glaziologischen Beobachtungen auf der dänischen Forschungsreise quer durch Nordgrönland 1912/13.** Map, diagrs., ills. *Zeitschr. für Gletscherkunde*, Vol. 10, 1916, No. 1, pp. 1-43.

O'NEILL, J. J. **Geological reports, Canadian Arctic Expedition, 1915.** *Summary Rept. Geol. Survey of Canada for 1915*, pp. 236-241. Ottawa, 1916. [See also references in note on "Return of the Southern Party of the Stefansson Expedition" in the September *Review*, p. 232.]

RASMUSSEN, KNUD. **Den II. Thule-Ekspedition til Nord-Grønland.** Map. *Geografisk Tidskrift*, Vol. 23, 1915-16, No. 5, pp. 198-200. Copenhagen. [Detailed plans of the 1916 trip, which were summarized in the July *Review*, pp. 65-66.]

WORLD AS A WHOLE AND LARGER PARTS

SCOTT, W. B. **A history of land mammals in the western hemisphere.** xiv and 693 pp.; ills., index. The Macmillan Co., New York, 1913. $5. 9½ x 6½.

The author says: "The western portion of North America has preserved a marvelous series of records of the successive assemblages of animals which once dwelt in this continent; and in southernmost South America an almost equally complete record was made of the strange animals of this region." A wish to make this history intelligible led to the preparation of this book.

The work is primarily intended for the layman, yet it cannot fail to be of interest to those zoölogists who are interested in evolutionary theories. The first four chapters discuss methods of studying rocks and fossils, the classification of mammals, and the geographical development of the Americas in Cenozoic time. The geographical distribution of mammals receives very adequate treatment. Among the factors that determine the presence or absence of any species of animals, the author mentions climate, mountains, plateaus, rivers, deserts, and preoccupation by another species.

Moreover, he calls attention to the fact that the climate may have little to do with the presence or absence of any particular species. Thus many plants and animals, when artificially introduced into a new country, often multiply prodigiously, as the rabbit in Australia, the English sparrow in America, the gypsy moth in New England, etc.

A very interesting discussion of the succession of mammalian faunas in North and South America follows. The author shows that the llama, camel, and horse are really derived from a long line of ancestors which originally were native to North America but are now scattered abroad. This is surprising from a geographical point of view, although it is even more surprising to find that there were elephants and their relatives, the mastodons, living in North America. It is thought the mastodons were known to the early Indians. The elephants undoubtedly came from northern Asia by way of Alaska, where Bering Land (now the bed of Bering Sea) connected it with Asia. At least ten species of the horse roamed Mexico and the United States even into Alaska, but not the ancestor of the modern horse.

Other chapters deal with the early geological history of the horses, pig-like animals, carnivora, and the monkey-like animals. Concerning man, he says: "There can be no question that man originated in the eastern hemisphere and at a very remote period. Abundant remains of his handiwork and of himself have been found in Europe as far back as the Pleistocene, and recent discoveries in England have increased the already known length of human habitation in Europe."

A final chapter discusses the different ways in which mammalian evolution may have come about. Whether some species came into existence suddenly (as mutants) or by slow, continuous processes, is a question still unsettled and likely to remain so. The work is abundantly and well illustrated and contains a glossary and complete index.

R. W. SHARPE.

PHYSICAL GEOGRAPHY

METEOROLOGY AND CLIMATOLOGY

BIGELOW, F. H. **A meteorological treatise on the circulation and radiation in the atmospheres of the earth and of the sun.** xi and 431 pp.; diagrs., index. John Wiley & Sons, Inc., New York, 1915. $5.00. 9½ x 6.

The title used on the back of the book, "Atmospheric Circulation and Radiation," is undoubtedly the one by which it will be known to students of meteorology; but inasmuch as a large part of the volume deals with problems of the solar atmosphere, the title page, as given above, is a more exact designation.

There are certain books in every science which distinctly mark transitional periods in the development of that science. In meteorology, Ferrel's "Popular Treatise on the Winds," published in 1889, may be instanced as such a book; and we think that the present volume may be put in the same class. As with Ferrel's book, so, too, this book is the outcome of many years of professional service. It sums up the matured thought of one who has been long in official harness and who knows the weakness of much that passes as authoritative. Bigelow has been something of a pioneer in the thermodynamics of the atmosphere and, if we may borrow a figure from woodcraft, has blazed a trail and made the way easier for the rest of us. In this book the author recognizes that the atmosphere is a real atmosphere, not an ideal one, as is generally assumed in mathematical treatises. It is a non-adiabatic atmosphere, and the gas coefficient, the so-called constant R in the characteristic equation, has different values at different heights, in the free air; and there is variability in specific heat. In fact there could be no circulation and no radiation such as do exist unless the specific heat did vary.

A most laudable purpose of the author is to save labor to other workers by giving full tables of equivalent values and conversion factors with numerous examples and results conveniently tabulated. All workers in meteorology, or shall we say aërography, long for the time when a single and uniform set of units shall be used. Bigelow brings together three systems of units, or rather three series of constants in three systems of units, and gives us gravitational force values in meter-kilogram-second, centimeter-gram-second, and foot-pound-second units, then mass or values of weight in the same three sets, and finally heat values. He prefers the first of them and suggests incidentally that if the divisions on the barometer scale be made 0.75 millimeter, the scale distance becomes 100 units of force; and pressure readings become immediately available for all forms of dynamic and thermodynamic meteorology. This scale, he holds, is equally valuable for public purposes and synoptic chart construction. Bigelow also says "that it would improve matters greatly to mark barometers in terms of pressure of an atmosphere at sea-level and thermometers in degrees absolute." He makes no reference, however, to the use of the *megabar* atmosphere and the system employed at the

Blue Hill Observatory for at least two years, where the pressure is given in units of force, the level at which one million dynes is found being regarded as the base instead of sea-level. Thus a *kilobar* (one thousand bars or dynes) is the thousandth of an atmosphere and a far more convenient unit than the one proposed above. Nor do we find a reference at this point to the suggestions of Köppen, Bjerknes, and others, nor to Gold's paper on barometer readings in absolute units.

A characteristic generalization is found in equation No. 27, which shows that for unit mass the force of gravitation must be balanced by the change in pressure, the kinetic energy of circulation, and the radiating heat. While the sum of the energy of circulation and radiation can be computed through the difference of the specific heats, there is no way to separate the two except through direct observation of the velocity. In the free air, the three terms, gravitation, pressure, and circulation seldom balance, and hence equations based on adiabatic conditions do not give complete solutions of thermodynamic problems of the atmosphere. This is Bigelow's point of departure, and in our opinion marks the transition in the status of meteorology spoken of above.

One gets the impression that certain equations are used as foundations for rather lofty superstructures. There is another matter of minor importance but worth mentioning, and that is the use of the same symbol to represent entirely different quantities, and this even on the same page. Thus the all-important R does double duty as gas constant and radius of the earth. Meteorological writers from Ferrel to Bjerknes have been careless in this respect, and certain letters like g and r are as changeable as chameleons. The trouble arises from the fact that equations used in astronomy, geodesy, and physics have been carried over into meteorology.

Table 7 gives a summary of formulas and constants from the kinetic theory of gases for the atmosphere in the C. G. S. system, a much-needed table and the first of its kind; but we could wish that the value of an atmosphere had been taken as 1,000,000 dynes instead of the sea-level value of 1,013,235 dynes. Chapter II deals with working non-adiabatic equations and again emphasizes the effect of the absorption of solar radiation and the emission of atmospheric radiation in various ways. We have, as exemplified in Tables 14 and 19, practically a new thermodynamic meteorology. In Chapter III, entitled "The Hydrodynamics of the Atmosphere," there is an extended analysis of the forces of rotation and an application of the equations of motion to Ferrel's local cyclone and the German local cyclone. Isobars are centered as circles upon the vertical axis, though this is not the case in nature, as Bigelow points out, except in waterspouts, tornadoes, and hurricanes. Then follows a discussion of funnel-shaped and dumb-bell-shaped vortices in which use is made of Stokes's functions. Chapter IV, consisting of 64 pages, is to the meteorologist the most important chapter of the book, dealing as it does with the structure and construction of ocean and land cyclones and containing a clear and well-put historical review of the three leading theories of the physical causes of storms. These theories are: (1) Ferrel's warm-center and cold-center cyclones; (2) Hann's dynamic production of temperatures as found by observation; (3) Bigelow's asymmetric cyclone with warm and cold currents arranged in ridges, or streams of different densities and driven into local cyclonic and anticyclonic circulations by the force of gravitation.

Chapter V treats of radiation, ionization, and magnetic vectors in the earth's atmosphere. The theory of the pyrheliometer is given in detail, with examples of the relative steadiness of the radiation at stations having different elevations, with evidence tending to show that effective radiation at low levels is less than 2 calories; and that about 2.1 calories is reflected back to space, escaping direct observation, so that the true solar constant is really more than 4 calories per square centimeter per minute. This of course brings into question the mean value as given by Abbot of 1.93 by various observations; and the latest value obtained by balloon instruments at 22,000 meters of 1.88 calories for the date of ascent. One remark seems fair and worth remembering by all concerned in the controversy, that "at present one must be very conservative in attributing to solar radiation the entire apparent variation of the radiation measured by pyrheliometer and bolometer."

Bigelow's figure for the solar constant is 4.047 calories and for the temperature of the solar photosphere 6900° A.

Chapters VI and VII treat of thermodynamic values to the top of the atmosphere, and we have for the first time the complete story to a height of 50,000 meters. Figures 74 and 75 are significant, as is also Table 85, where thermodynamic data are extended from the 40,000-meter to the 90,000-meter level. The stratosphere, or so-called isothermal layer, from 11,000 to 38,000 meters, is defined as merely that part where the surviving solar radiation nearly balances the terrestrial radiation.

The typographical make-up of the book is excellent. ALEXANDER MCADIE.